REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

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1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
01-07-2012	Technical	August 2011-July 2012

4. TITLE AND SUBTITLE

Kwajalein Infrastructure Prioritization Methodology

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

Cadets Herbert Jockheck, Kevin Ryan, Brenden Siekman and LTC Kenneth McDonald, PhD

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Center for Nation Reconstruction and Capacity Development
Department of Systems Engineering
Mahan Hall, Bldg. 752, West Point, NY 10996

8. PERFORMING ORGANIZATION REPORT NUMBER

2012-5

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Assistant Chief of Staff for Installation Management
Room 3E474 Pentagon
Washington, DC 20314

10. SPONSOR/MONITOR'S ACRONYM(S)

ACSIM

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

NA

12. DISTRIBUTION/AVAILABILITY STATEMENT

DISTRIBUTION A. Approved for public release; distribution is unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

The Reagan Missile Test Site operates in the Kwajalein Atoll, testing missiles for Space and Missile Defense Command. This army base located on Kwajalein to test these missiles is not up to code as an army installation. To update the base to Army standard will cost around $500 million, which is not plausible for the small installation. The buildings and infrastructure on Kwajalein are failing apart and if not fixed they could hinder or ruin the base's ability to execute their mission. The proposed model ranks different projects that will fix the installation, based on values that nest into supporting the mission on Kwajalein. To narrowly define the problem, we interviewed stakeholders and sent out surveys to the residents of Kwajalein in order to understand what they valued and what the garrison looked like from their perspectives. Multiple Objective Decision Analysis (MODA) was conducted to compare the different value measures together. Since each value measure is rated differently, it would be difficult to compare them to one another if there was no way to bring them under one type of measurement or unit; MODA allows us to do this.

15. SUBJECT TERMS

infrastructure prioritization, Multiple Objective Decision Analysis, Kwajalein Atoll, resource analysis

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Dr. Kenneth McDonald
	UU		None	64	19b. TELEPHONE NUMBER *(Include area code)* 845-938-4752

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Standard Form 298 (Rev. 8/98)
Prescribed by ANSI Std. Z39.18

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July 2012

Kwajalein Infrastructure Prioritization Methodology

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Report 2012-5
DTIC: AXXXXXXX

Abstract

The Reagan Missile Test Site operates in the Kwajalein Atoll, testing missiles for Space and Missile Defense Command. This army base located on Kwajalein to test these missiles is not up to code as an army installation. To update the base to Army standard will cost around $500 million, which is not plausible for the small installation. The buildings and infrastructure on Kwajalein are failing apart and if not fixed they could hinder or ruin the base's ability to execute their mission.

As a solution to this problem, our capstone team developed a prioritization model for the army base. This model ranks different projects that will fix the installation, based on values that nest into supporting the mission on Kwajalein. To build this priority model, we used the Systems Decision Process (SDP). This process allows us to analyze the situation and create a solution to this problem. The SDP consists of four phases: problem definition, solution design, decision-making, and solution implementation. Each step is crucial, but our project will primarily focus on the problem definition and solution design. The SDP stresses the importance of stakeholder value, so throughout the project we worked closely with the Department of Public Works (DPW) on Kwajalein. The DPW's higher command has changed during the construction of the model, but they still plan on implementing this solution.

In our first step of this process we defined the problem. Creating a solution to a problem does not have any effect if it is not a solution to the actual problem. To narrowly define the problem, we interviewed stakeholders and sent out surveys to the residents of Kwajalein in order to understand what they valued and what the garrison looked like from their perspectives. We also visited Kwajalein to see the ground truth that fully allowed us to understand the complexity of this problem.

From this stakeholder analysis we collected the data into a Findings-Conclusion-Recommendations table to enable analysis. In the next step we decided to build a computer model to solve our redefined problem. This will help the stakeholders objectively understand which projects will be most beneficial to the base.

Multiple Objective Decision Analysis (MODA) was conducted to compare the different value measures together. Since each value measure is rated differently, it would be difficult to compare them to one another if there was no way to bring them under one type of measurement or unit; MODA allows us to do this. The swing weight matrix was then completed in order to compare the value measures in their importance. The completion of value scoring allowed us to complete the model.

The computer model utilizes Microsoft Excel. Its simple interface makes it easy for the stakeholder to use. The stakeholder is only required to input the information for each project, including the cost and a description of the project. Once this is complete, there are several different features that the user can utilize. The model produces a prioritized rank of projects from their costs and total values. The model also allows reports to be printed so that the user can present the data in a professional and easily understandable manner.

The Assistant Chief of Staff for Installation Management funded this effort.

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About Us

The Superintendent of the United States Military Academy (USMA) at West Point officially approved the creation of the Center for Nation Reconstruction and Capacity Development (C/NRCD) on 18 November 2010. Leadership from West Point and the Army realized that the United States Army, as an agent of the nation, would continue to grapple with the burden of building partner capacity and nation reconstruction for the foreseeable future. The Department of Defense (DoD), mainly in support of the civilian agencies charged with leading these complex endeavors, will play a vital role in nation reconstruction and capacity development in both pre and post conflict environments. West Point affords the C/NRCD an interdisciplinary and systems perspective making it uniquely postured to develop training, education, and research to support this mission.

The mission of the C/NRCD is to take an interdisciplinary and systems approach in facilitating and focusing research, professional practice, training, and information dissemination in the planning, execution, and assessment of efforts to construct infrastructure, networks, policies, and competencies in support of building partner capacity for communities and nations situated primarily but not solely in developing countries. The C/NRCD will have a strong focus on professional practice in support of developing current and future Army leaders through its creation of cultural immersion and research opportunities for both cadets and faculty.

The research program within the C/NRCD directly addresses specific USMA needs:

- Research enriches cadet education, reinforcing the West Point Leader Development Systems through meaningful high impact practices. Cadets learn best when they are challenged and when they are interested. The introduction of current issues facing the military into their curriculum achieves both.
- Research enhances professional development opportunities for our faculty. It is important to develop and grow as a professional officer in each assignment along with our permanent faculty.
- Research maintains strong ties between the USMA and Army/DoD agencies. The USMA is a tremendous source of highly qualified analysts for the Army and the DoD.
- Research provides for the integration of new technologies. As the pace of technological advances increases, the Academy's education program must not only keep pace but must also lead to ensure our graduates and junior officers are prepared for their continued service to the Army.
- Research enhances the capabilities of the Army and DoD. The client-based component of the C/NRCD research program focuses on challenging problems that these client organizations are struggling to solve with their own resources. In some cases, USMA personnel have key skills and talent that enable solutions to these problems.

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Chapter 1
Introduction

1. Project Overview

The Ronald Reagan Ballistic Missile Defense Test Site (RTS), on the Island of Kwajalein, Republic of the Marshal Islands (RMI, see Figure 1.1), is used by the Space and Missile Defense Command (SMDC) as a range to normally test missiles for the United States (U.S.) Army and other Department of Defense (DoD). The Army base on Kwajalein is in substandard conditions for infrastructure and does not meet current Army standards in many areas. Strategically, the SMDC has chosen to invest scarce resources in the tracking, launch, and other mission essential facilities in lieu of facilities modernization, real property maintenance, and other operations and maintenance activities that support base operations. Thus, the cost to bring RTS up to Army standard is estimated to exceed $500M in 2011 dollars. Currently the SMDC is transitioning ownership of the RTS to the U.S. Army Installation Management Command (IMCOM). Dedicated to taking care of people and projecting the force, the IMCOM is charged with providing equitable, effective and efficient management of Army installations worldwide. This research focused on developing a decision support tool in the form of a model that prioritizes which projects will be most valued by the Army and the other primary stakeholders. This tool can be used at the Directorate of Public Works (DPW) or up to IMCOM level to assist in strategic planning and resource prioritization and allocation.

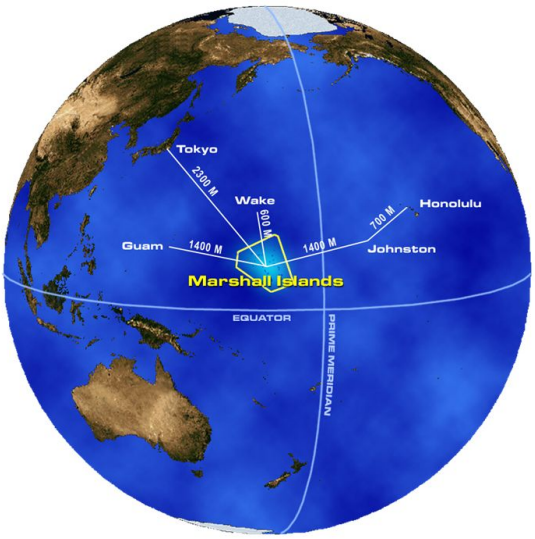

Figure 1.1 *Location of the Marshall Islands*

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Chapter 2
Literature Review

2.1 Why the Marshall Islands

Kwajalein Atoll[1] is west of the International Date Line, was seen as an ideal location for missile defense in the 1950s, as it would be the first place to have eyes on any Asian launches. Kwajalein's remote location and few inhabitants make it ideal for missile testing in the past and still today. Other atolls in the RMI were used for nuclear tests in the 1940s and 50s. Today, Kwajalein is still used for ballistic missile testing by the U.S. The lagoon in the middle of the Kwajalein Atoll is the largest in the world. On and around the eleven islands the U.S. leases, missiles can freely smash into the water or the land. Other functions performed on the Kwajalein Atoll include launching missiles, tracking foreign launches and objects currently in space, and technology development (Lopez, 2011).

Because of its location on the world's largest atoll and few populations nearby, RTS is a premier missile test facility. Missiles and defense systems are tested in conjunction with California and Alaska launch sites. Between 2003 and 2013, the U.S. has committed $1.5B to RTS. In the past, though Kwajalein was used on missile defense technologies, these programs tended to be over budget and over time. Risk analysis has been used since then, but these risks remained consistent with these programs (Cordesman, 2011). However, testing in this area of ground-based radar on Kwajalein has had its successes. These successes have been tested and fielded and are currently being implemented in East Europe (Samson, 2011).

China does have a growing influence in the region and the Bush Administration considered the Kwajalein Test Site critical as it is used for space monitoring, missile testing and ICBM testing. The Free Association States such as RMI and Micronesia also serve as a buffer between Chinese influenced states and Guam. This buffer has become more important since the U.S. withdrew their U.S. Agency for International Development (USAID) program from the Pacific in the 1990s (Lum, 2007).

In conclusion, because of the huge strategic importance of maintaining such a perfect location for missile testing, Kwajalein should be maintained well. It should at least be maintained for its importance as a connection with the free association states between the U.S. and China. The Army must decide the strategic value of Kwajalein terms of total funding priority with regards to base maintenance because of the gains it provides to military missile development and civilian space travel advancement.

2.2 Background

The RMI is located in South Pacific Ocean and are part of a group of islands known as Micronesia. Micronesia is derived from a Greek word, which means small islands (Price, 1944). As part of Micronesia, the Marshall Islands are considered coral islands. This means they are flat, sandy and contain little vegetation.

The RMI has a long history of foreign occupation with the most recent occupation being the U.S. The past 70 years of RMI history has been intertwined with the U.S. resulting in an intricately linked international bond between the countries.

The first settlement of the Marshalls came before 1500 B.C. when native peoples from the Philippines and Indonesia who had settled some other islands of Micronesia reached their population capacity on the islands of Truk, Ponape, and Kosrae (Goodman and Moos, 1981). Magellan was the first European explorer to hit Micronesia when he landed on the Mariana Islands, but the Marshall Island largely remained ignored by Europeans until the 19th Century. The British Captain Marshall discovered many of

[1] An atoll is a coral island (or islands) that encircles a lagoon partially or completely (from Wikipedia, 2011)

the islands in the Marshalls in 1788 (Wiens, 1962). Germany formally annexed the Marshall Islands in 1885 (Peattie, 1988) and by 1906 they were combined with the Marinas, Paulaus, and Carolines to form one administrative territorial group (Goodman and Moos, 1981). The colonization by Germany had a major economic impact, as copra (coconut meat) trade became one of the most sought after products in the Pacific. The trade began before Germany annexed the islands, but by the time the formal annexation occurred, the Marshalls were a top source of copra. The economy was not the only thing affected, however. The political system of the Marshall Islands also came under influence of the Germans. The local chiefs still retained their positions, but they essentially became political puppets for the Germans, as enforcing the German's policies were in their personal interest. By 1906 the Marshallese had become discontented with the Germans.

The indigenous religions of the native peoples were replaced with European Christianity, but the main influence in the Marshall Islands before WWII was the Japanese (Wiens, 1962). In 1914, the Japanese took the unguarded Marshalls from Germany with a naval force, but it wasn't until six years later that the Japanese officially ruled the Marshalls as granted by the League of Nations. Once it gained official rule of the islands, Japan used many more officials to administrate their territory than the Germans ever did (Goodman and Moos, 1981). Some parts became overcrowded in the Marshalls such as Ebeye Island, part of the Kwajalein Atoll (Peattie, 1988). One lasting impact the Japanese had was the payment of local chiefs. When the Japanese officials began moving in on the islands they relinquished the political power the chieftains had and instead paid them money. The Japanese also began trading with the Marshalls mainly harvesting meat from the coconut, just as the Germans did before them. Previously the Marshallese had no use or need for money, but now started to buy cheaply made Japanese goods, slightly increasing their standard of living. The people became more assimilated into Japanese culture as some were educated with the Japanese and learned the harsh manner in which the Japanese dealt with infractions. Through the years of foreign administration, the Marshallese became a people used to foreign control. While the people themselves were not treated too poorly, they were second-class citizens in the eyes of the foreign occupants, not truly treated equally or with as much respect as deserved.

In 1932, Japan left the League of Nations, closed its islands to foreigners, and eventually created a series of defenses (Trumbull, 1959). Early in WWII, the Marshall Islands were identified as an important stepping-stone to Japan, says Willard Price, an author who travelled to Micronesia during the war. He quoted a Japanese admiral when he said that Micronesia was the "key to the Pacific ". The reason the Marshalls were eyed specifically was the geography, as it provided excellent bases from which to launch further campaigns (Price, 1944). The Marshall Islands are coral islands and therefore did not make good forts themselves, but did make a great place for a strategically placed runway (Peattie, 1988). The Japanese recognized the potential strategic value of the Marshall Islands in the years immediately preceding WWII. This strategic value was mostly inherent in the location of the islands, as any U.S. Naval advance towards Japan would have to come within striking distance of the Marshalls.

The assault on Kwajalein Island occurred on February 1, 1944 after prolonged bombardment of the island. The bombardment was quite extensive and destructive as 313 tons of bombs were dropped on the Kwajalein Atoll. The U.S. decided to bombard the island this heavily due to the high number of casualties when taking Tarawa which was fought with much less pre-bombardment. This strategy was successful in reducing of number of friendly casualties. In fact the Kwajalein Atoll battles had over one thousand less casualties that the battle of Tarawa. The friendly casualties saved came at the cost of local inhabitants, however.

Under the command of Major General Charles H. Corlett, the 32nd and the 184th Infantry Regiments from the 7th Infantry Division were the American units with first boots on the ground. The Americans finally controlled the island after four days of intense fighting, although the island was destroyed from the pre-invasion bombardment (Marshall, 1945). The invasion of Kwajalein Island was the first penetration into the Japanese ring of defenses (Trumbull, 1959). Once the Kwajalein Atoll was captured, further islands in the "island hopping" strategy were more easily accessible, and the trail to Japan was opened. Although

the Kwajalein atoll was taken by the Americans along with some other atolls in the Marshall Islands, some were left in Japanese control, namely Jaluit, Wotje, Mili, and Maleolap. American propaganda convinced some Marshallese left on the Japanese controlled islands to defect and come over to the American controlled islands. The Japanese responded by severely punishing anyone found to be helping the Americans to include capital punishment and torture (Peattie, 1988). The remaining Japanese eventually became rendered useless as they began to starve once isolated from the rest of the Japanese forces.

Once WWII ended, the Marshall Islands were recognized as a strategically important site in the Cold War and Korean War. Controlling the Marshalls, the U.S. converted the Bikini Atoll into an atomic weapons test site and the Kwajalein Atoll into a missile site (Wiens, 1962).

In 1947 the U.S. become the lone administrators of the Marshall Islands under an official U.N. trusteeship (Trumbull, 1959). Maynard Neas was one of the first American administrators to successfully communicate with the Marshallese about the U.S. aid plan after the war. Neas helped show the importance of elected officials to the Marshallese by giving food intended for distribution to their elected officials. He also helped restore the coconut, the cash crop of the Marshallese, to several of the islands that were devastated by Typhoon Ophelia. Since the trusteeship was formed, the U.S. has used the Marshall Islands for military testing, first for nuclear weapons, but also for ballistic missiles. Nuclear weapons testing ended in 1958, and the anti-ballistic missile defense system named Nike-Zeus began. The first four launches were in 1962, but were unsuccessful (Johnson, 1986). The base on Kwajalein forced many Marshallese to live on the crowed Ebeye Island, but it also paid them handsomely, contributing more income than all of the Marshallese copra combined. Not all were able to enjoy benefits of pay, however, and many were unsatisfied. The people relocated to Ebeye from the mid atoll corridor were especially angry.

The RMI adopted a constitution and elected officials to parliament and became a sovereign state by 1986. Once it became a sovereign state, RMI was not free from problems. In December 2000, the people of Ebeye had a cholera outbreak with a 6% fatality rate (Beatty, et. al, 2005). Researchers determined that the water had come from Kwajalein Island, but was not chlorinated enough to kill the bacteria it collected when back on Ebeye. RMI did make money from the U.S. occupation of its territory, however. From 1986 to 1999, RMI collected $180M in compensation payments for nuclear damage and another 250 million for the Land Use Agreement (Fraenkel, 2002).

The U.S. pays the Kwajalein Atoll landowners in accordance with the land use agreement signed on October 19, 1982 (Compact of Free Association, 1986). In the 2003 Compact of Free Association[2], the U.S. Government agreed to pay $15M for the use of the mid atoll corridor on Kwajalein Atoll increasing to $18M by 2014 (Compact of Free Association, 1986).

The U.S. Federal Aviation Administration told RMI that the Majuro airport needed repaved and gave an estimate of $8-10M (Importance of Immediate Development, 2011). Like any developed island, the airport is an important part of operations for both Majuro and Kwajalein. It is the only practical way to connect the Marshall Islands to the outside world. One problem facing the Marshallese is the quick deterioration of buildings due to sand and slat water erosion.

[2] A Compact of Free Association (COFA) defines the relationship that each of three sovereign states—the Federated States of Micronesia (FSM), the Republic of the Marshall Islands (RMI) and the Republic of Palau—have entered into as associated states with the United States. Under the COFA relationship, the United States provides guaranteed financial assistance over a 15-year period administered through the Office of Insular Affairs in exchange for full international defense authority and responsibilities.The COFA allows the United States to operate armed forces in Compact areas, to demand land for operating bases (subject to negotiation), and excludes the militaries of other nations without U.S. permission. The U.S. in turn becomes responsible for protecting its affiliate nations and responsible for administering all international defense treaties and affairs, though it may not declare war on their behalf. Taken from Wikipedi (2011).

2.3 Nuclear Testing in the Marshall Islands

In 1946, the U.S. tested nuclear weapons in the Bikini Atoll (Trumbull, 1959). By August 1958, 67 nuclear weapons tests had been conducted on or near the Marshall Islands. The people of the Marshall Islands have a strong tie to their specific atoll, and moving them not only disrupts their lives, but the spirits of their ancestors and those not yet born. Part of the move included Kwajalein, as the Bikinians were moved first to the Rongerik Atoll, then Kwajalein, then Kili Island. The displacement of the Marshallese also included residents of Eniwetok, who were moved to the Ujelang Atoll, and residents from the Uterik and Rongelap Atolls, who were moved when radioactive fallout from the 1954 hydrogen bomb testing dropped on these unsuspecting islands. In all, nuclear testing in the Marshalls caused the displacement of people in four atolls, and the radiation contamination of 253 residents. Dislocation was not the only problem, however. Several Marshallese people were exposed to nuclear fallout from the tests and developed cancer. 20 out of 66 nuclear tests resulted in nuclear fallout in inhabited areas of the Marshall Islands. Castle Bravo, the biggest nuclear test in the Marshalls, resulted in radiation levels three times higher than normal in children and adults in Rongelap.

In 1986, the Compact of Free Association was passed with section 177 specifically outlining compensation for nuclear testing in the Marshalls. The U.S. assumed full responsibility and delivered the following message in subparagraph (b):

> *The Government of the United States and the Government of the Marshall Islands shall set forth in a separate agreement provisions for the just and adequate settlement of all such claims which have arisen in regard to the Marshall Islands and its citizens and which have not as yet been compensated or which in the future may arise, for the continued administration by the Government of the United States of direct radiation related medical surveillance and treatment programs and radiological monitoring activities and for such additional programs and activities as may be mutually agreed, and for the assumption by the Government of the Marshall Islands of responsibility for enforcement of limitations on the utilization of affected areas developed in cooperation with the Government of the United States and for the assistance by the Government of the United States in the exercise of such responsibility as may be mutually agreed. This separate agreement shall come into effect simultaneously with this Compact and shall remain in effect in accordance with its own terms (Compact of Free Association, 1986).*

The “compensation” payments continue to this day. In 2010, a Nuclear Compensation Act was passed with the purposes of providing “supplemental *ex gratia* compensation”, “expanding the scope” of existing programs, and assessing the health impacts on the Marshallese people. The Senate unanimously passed the act in 2010, after being originally drafted at the request of the president of RMI (United States. Congress Senate. Committee on Energy and Natural Resources, 2010).

2.4 Government Background

The Kwajalein Atoll is just one of the many atolls that are considered part of the Marshall Islands. Understanding the form of government Kwajalein is under and certain events that occurred helps us understand more about the way Kwajalein operates. This is important because the more we understanding how Kwajalein operates, the better chance the U.S. Army has of keeping good relations with them.

The government that the Marshallese Islands have is a Representative Republic. In 1986 they gained their independence from the U.S. “under a Compact of Free Association” (CIA World Factbook, 2011). In 1983 the Marshall Islands set up their constitution and chose their first president.

The government is set up as a “mixed parliamentary-presidential system,” where they have a bicameral parliament, with a president as the head of the state (Embassy of the Republic of the Marshall Islands, 2011). The bicameral parliament consists of two houses, the Nitijela and the counsel of Iroij. The Nitijela holds the Legislature power and it consists of 33 members. There are 24 districts that members are elected from and there is a designated amount of members that are allowed for each district. From Kwajalein there are 3 members that represent them in the Nitijela, having the second most amount of

representatives than any other district. People 18 years of age can vote the members of the Nitijela in office and at the age of 21 a citizen can officially run to be a member of the Nitijela (Constitution of the Republic of the Marshall Islands, 2011). Members or Senators of the Nitijela are elected for 4-year terms (About the Marshall Islands, 2011).

The council of the Iroij's main function is to reconsider bills that the Nitijela passes. This council can reconsider any bills that deal with customary law, land tenure, or traditional practice." This helps preserve the culture of the Islands and their own rights as individual islands. As written in the Marshallese constitution, "The Council of Iroij shall consist of 5 eligible persons from districts of the Ralik Chain and 7 eligible persons from districts of the Ratak Chain of the Marshall Islands" (Constitution of the Republic of the Marshall Islands, 2011). These 12 members are known as Chiefs (Embassy of the Republic of the Marshall Islands, 2011).

As The head of the State, the president is also the head of government ("CIA World Factbook"). The Nitijela elects him, with a majority of votes from its members (Constitution of the Republic of the Marshall Islands, 2011). The president then chooses his cabinet members, with the Nitijela approving the selections (Embassy of the Republic of the Marshall Islands. 2011). There have only been five presidents in the history of the Marshall Islands. Four out of these past five have been Chiefs, or were once in the Council of Iroij (Huge Funeral Recognizes Late Majuro Chief, 2011). The current President is Jurelang Zedkaia (Office of the President, 2011). Eighteen Years of age is the official year that people can start voting.

Understanding the form of government and how they operate can affect how USAKA operates. The people elected to power can affect relations with USAKA. Knowing how their government operates can help us not make any decisions that will conflict with this system or any laws they could pass.

2.5 Current U.S. Operations on Kwajalein

The U.S. Army Kwajalein Atoll (USAKA) is responsible for the Reagan Missile Test Site, "testing theater missile systems," and "to support space operations" (Bigelow). They are a "government-owned, contractor-operated (GOCO) installation" (U.S. Army Kwajalein Atoll Regan Test Site"). Knowing the relationship between USAKA and the Marshallese people can be effective in helping fix the base on Kwajalein. Decisions made on this project can and this relationship with the Marshallese people and in the future could complicate things.

USAKA leases 11 out of the 100 islands to run missile tests through RTS (USAKA Base Operations, 2011). In charge of the U.S. Army Kwajalein Atoll is Colonel Joseph N Gaines. As the commander since 2008, Colonel Gaines has been pushing for friendly relations with the Marshallese people (Bigelow). He is quoted as saying, "We stand ready to support our neighbors in Ebeye, especially when there is a health, life, or safety issue" (Lopez, 2011). With his "good neighbor policy" Colonel Gaines and USAKA has helped the Marshallese people in many occasions. In November of 2010, USAKA provided the Island of Ebeye with 40,000 gallons of fresh water because they were having trouble generating their own (Rowa). Another simple example is when a softball game was set up between USAKA staff and the Marshallese people (Bigleow, 2011). Events like these help keep good relations with the people. Gaines said, "We will not hesitate to respond and support the Marshallese people. A good portion of our workforce comes from Ebeye and they are an important part of our community."

The number two employer for jobs of the Marshallese people is USAKA. USAKA employs around 1,000 RMI workers. Due to the recent budget cuts, USAKA will have to lay off U.S. and Marshallese employees. As of now, they will be reducing the workforce to 912 members. Along with eliminating jobs, 350 workers will have their work hours reduced. Most of these job layoffs consist of public works and custodial jobs (RMI Dismayed at USAKA Workforce Reduction, 2011). These job cuts will be in effect on October 1, and it is thought that it will have greater effects than a loss of jobs. The former Foreign Ministry of Finance "estimates that the cuts will reduce taxes coming to the RMI government by $1 million a year" (The

Marshall Islands Journal, 2011). As the second most employer to the Marshallese people, USAKA affects the people and government of the Islands.

If the U.S. Army decided to make Kwajalein an unaccompanied tour, then this would have an effect on the relations between USAKA and the Marshallese people. An unaccompanied tour would consist of a cut down of workers because they have the means to operate from their headquarters in Alabama. Having minimal number of workers in Kwajalein would mean that a lot of Marshallese people would be losing their jobs. Finding work is difficult in Kwajalein, so this would have drastic effects on the people as a whole and their economy. As a result the Marshallese government could require more money to use their land and operate on it. Understanding USAKA relations can help prevent these situations from occurring.

Missile Command

The SMDC has authority over U.S. Army Kwajalein. The SMDC is currently considering and implementing many changes involving the RTS such as increased information flow, improving range accessibility, and enhancing interoperability with customers and other ranges. This program will save time and money for customers by decreasing the time it takes for them to see results on the mainland (U.S. Army Kwajalein Atoll). These advances increase the volume of operations at Kwajalein.

Installation Management Command (IMCOM) activated in October 2006 was a consolidation of the Installation Management Agency (IMA), the Community and Family Support Center, and the U.S. Army Environmental Center (USAEC). Before IMCOM installation services were inconsistent for soldiers and families based on the post which diverted the war-fighter's purpose (U.S. Army Installation Management Command). Installation Management Command (IMCOM) was created to avoid redundant spending and create separation of commands. Before IMCOM, there were conflicts in which funding that was intended for installations was spent on training amongst other issues (Resty, 2003). IMCOM could possibly be instated at Kwajalein, which would affect the maintenance problem.

Ronald Reagan Test Site

The U.S. for missile testing since the 1960s has used Kwajalein. Throughout its use, land-lease agreements have been rough. In the 1970s and 1980s Marshallese led sail-in protests that increased the lease amount from hundreds of thousands to millions of dollars. In 2001, the president of the Marshal Islands said he would prefer to give the U.S. indefinite use of Kwajalein in exchange for trust fund (Keith-Reid, 2011).

RTS is a premier missile test facility and operates in conjunction with California and Alaska launch sites. In 2002 SMDC awarded a $626 million contract to Kwajalein Range Services, a Bechtel-Lockheed Martin contracting company that currently manages technical operations and provides logistical support to RTS. Over the next 10 years, U.S. will spend $1.5B on tests involving RTS.

Two challenges that face new projects at Kwajalein involve the island's environment and the facility's environmental friendliness. Last year 130th Engineer Brigade went to Marshall Islands for four projects. Because of high salt and rain (over 100 inches/year) buildings have a very low life expectancy (Ross, 2011). And this year, the Senate Armed Forces Committee endorsed the DoD's Net Zero program that will require Kwajalein Atoll as well has five other bases to produce as much water and energy as they consume and add no solid waste to landfills by 2020 (Maze, 2011). The Navy believes a possible way to produce energy for the island test facility could be Ocean Thermal Energy Conversion (Williams, 2009).

Directorate of Public Works and Construction on Kwajalein

The Kwajalein DPW is currently responsible for providing a recommendation on resource allocation and project prioritization to the garrison commander. By better understanding the functions of the DPW and how it fulfills its' mission we hope to be able to make a model fitting to their needs and values.

The mission of the Kwajalein DPW is to, "Provide sustainable facilities and services to support and improve the quality of Hawaii's Military community and enhance Warfighter readiness and well-being" (DPW, U.S. Army Garrison, Hawaii). The role of the DPW on military installations has increased greatly over the last twenty-five years due to the focus on better facilities for soldiers and their families (Resty, 2003). DPW is also responsible for environmental safety and health, as well as hunting and fishing regulations (DPW Grounds Maintenance Service Contract Guide) (Facilities Engineering). A DPW is staffed by DoD civilians and is generally broken down into different divisions. Some of the typical divisions are planning, engineering, operations and maintenance, utilities, and business operations.

Contracting on Kwajalein

The majority of U.S. citizens on Kwajalein are contractor even though the facilities on Kwajalein are government owned. The Marshall Islands has its a police force of about 130 national police officers, but Kwajalein has its own police force of about 110. There are about 2,000 people on Kwajalein. 77 are DOD civilians and 22 are Army. There are about 1,000 independent contractors. In 2006 36 employees were moved from Kwajalein to Red Stone Arsenal, Alabama ("Security and Foreign Forces, Marshall Islands"). This is a trend that has occurred to downsize the number of people on Kwajalein.

Kwajalein Range Services (KRS) hires contractors on 12 and 24-month contracts for various jobs. They receive housing and meal supports based on whether they are single or have dependents. Contractors are expected to work a 5 day, 40 hour work week (Kwajalein Range Services). Kwajalein Range Services provides professional logistics and technology support. This translates to base operations and missions operations. As a company KRS inputs approximately $710,600,000 per year and employs 2,200 people ("Kwajalein Range Services, LLC"). These well defined contracts should provide a high level of output in both mission and base operations.

There are also private missile operations that launch out of Kwajalein. These are not just defense systems contractors but civilian companies that perform space travel and research. Because of Kwajalein's equatorial location, it is easiest to put objects into orbit from there. Currently Lockheed Martin, the supplier of contractors, also has contracts through the Defense Advanced Research Projects Agency to launch satellites from Kwajalein. Kwajalein's importance aids both military and civilian space and missile development.

GOCO

Government Owned, Contract Operated or GOCO refers to an installation that is owned by the Department of Defense (DoD) but operated by private firm under contract to the U.S. Government (Comparison of GOCO, 2011). Regulations dictate what is expected out of the contracted firm as well as what they are guaranteed by the Army. Most facilities that operate as GOCO are research or testing facilities (DoD Dictionary, 2011).

USACE

The U.S. Army Corps of Engineers or USACE mission is to, "Provide vital public engineering services in peace and war to strengthen our Nation's security, energize the economy, and reduce risks from disasters" (Mission and Vision, 2011). The Corps of Engineers has a subdivision known as the Construction Engineering Research Laboratory (CERL). This division is responsible for finding new technologies that help military installations maintain their quality of life, training lands, and facilities (Welcome to CERL, 2011). The USACE also helps with local emergencies in the U.S. such as hurricane and tornado relief, as well as providing engineering capabilities to soldiers deployed to combat zones (Frequently Asked Questions, 2011).

The USACE will be responsible for many of the projects planned for Kwajalein. With this in mind it is prudent to understand how the USACE operates and in what capacities they function. By creating a working valid model we may actually be able to assist not only the Kwajalein commander and DPW but

also help the USACE better understand the environment and situation into which they will be entering when the projects begin.

IMCOM

On a military installation, the Installation Management Command or IMCOM provides an environment in which soldiers and their families can thrive, a structure that supports unit readiness, and a foundation for building the future (IMCOM Mission, 2011). They are made up of a combination of Active military personnel and DoD civilians. The current commander of IMCOM is Lt. General Ferriter.

We initially did research on IMCOM because because authority for the maintanence and operations of Kwajalein was being transferred from SMDC. In 2012 they were appointed to take command of the Installation on Kwajalein. With this change in the installation it has had minor affects on our project. The model we present to the DPW on Kwajalein will still be applicable and can still be used by them regardless of the recent takeover of IMCOM. The funding for the base on Kwajalein will now come from IMCOM, possibly providing more funds for projects to fix the installation.

Chapter 3
Research and Stakeholder Analysis

3.1 Stakeholder Analysis

The DPW[3] at Kwajalein is our client in this project as he is in charge of the department that defines the system requirements. The owner of the system is responsible for the proper operation of the system. On Kwajalein, Colonel Gaines, the Commander of USAKA and RTS, owns the system. At the level above USAKA, LTG Richard P. Formica owns the system because he commands the Strategic Missile and Defense Command. Our point of contact for LTG Formica is Mr. Jeff Harrison. The final major stakeholder depends on if IMCOM will take responsibility of Kwajalein's installation. If it does, LTG Ferriter, Commander IMCOM, will also be a system owner and possibly a decision authority. A decision authority is a stakeholder with the ultimate authority to approve a solution (Driscoll, Henderson, and Parnell, 2011). Our points of contact for LTG Ferriter are Mr. Michael Hartman and Mr. Mark McClure. Table 3.1 below provides the details of our stakeholders.

Table 3.1 *U.S. Government stakeholder summary*

Stakeholder	Organization	Position	Type	Reason for Interest	Date of Interview
LTG Michael Ferriter	IMCOM	IMCOM Commander	Decision Authority	IMCOM is the source of funding for projects as of January 2012	1 Mar. 12
Mr. Mark McClure	IMCOM	IMCOM Pacific	Decision Authority		6 Oct. 11
Mr. Michael Hartman	IMCOM	IMCOM Deputy Chief of Staff	Decision Authority		27 Sep. 11
LTG Richard P. Formica	SMDC	SMDC Commander	Owner	Overall responsible for operations at USAKA	N/A
Mr. Jeff Harrison	SMDC	SMDC Engineer	Owner		5 Oct. 11
Mrs. Brenda Ellis	SMDC	Chief of the SMDC DCSEN Construction Division	Owner		1 Feb. 12
COL Joseph Gaines	USAKA	USAKA Commander	User	Overall accountable for operations at USAKA	29 Sep. 11
Mr. Jamie Heidle	USAKA DPW	Deputy DPW	Client	Soliciting Systems Decision Support, defines requirements	14 Sep. 11
Contractors/Families	USAKA		Consumer	Live on USAKA	14 Jan. 12

The data from our stakeholders was collected through interviews. We submitted a survey with the target audience being contractors on Kwajalein. The data that the survey covered aimed at drawing perspectives from the residents of the island and what they thought of their living conditions. This survey was submitted to the USAKA public affairs office. The information we received from these surveys reaffirmed our findings from the interviews and research.

We conducted four interviews via telephone conference call and video teleconference. We spent approximately one hour compiling each of their notes from the interview into a single group document. These compiled notes served as the findings for our FCR table.

[3] Mr. Jamie Heidle, Acting Director of DPW served as our primary customer for this work and was invaluable as a subject matter expert and advocate.

3.2 Findings Conclusions and Recommendations Table

The findings from the interviews were compiled into the FCR table. The findings and conclusions portions of the FCR can be found in Appendix A and are based mainly upon a site visit to RTS. We grouped similar findings into conclusions, and derived recommendations from conclusions that had similarities. Reoccurring themes from all interviews include the fact that all steps necessary to bring Kwajalein up Army standards are too expensive to complete at one time. The primary cause that let to Kwajalein coming to this state are a lack of contractor oversight and sacrificing base operations at the expense of funding mission support facilities. Table 3.2 contains the recommendations from the FCR.

Table 3.2 *Conclusions to recommendations*

Item	Conclusions	Recommendations
1	It costs too much to repair everything so a prioritization of projects is necessary	Projects need to be prioritized because cumulative costs of projects required to bring Kwajalein up to Army standard is too expensive, USAKA does not receive enough funding, and money tends to be used for mission needs
2	Major military construction (MILCON) projects need to happen because the sum of these projects is too expensive	
3	Lack of funding directed towards facility maintenance and oversight over a generation caused the current problem	
4	The money available goes towards mission needs	
5	Priority goes to infrastructure that impacts mission, and then to infrastructure that impacts health, safety, and quality of life.	The priority of projects should be based on the ranked stakeholder values of mission, health, safety, quality of life. The priority is subject to change based on the COA chosen at USAKA.
6	Airfield and Pier are 1st and 2nd because of their direct impact on mission	
7	There are a variety of other projects to include housing, waste water treatment, hospital and power plant that need to be prioritized	
8	COAs for the future of Kwajalein could change the prioritization. Such examples are unaccompanied tours, fixed firm contracts, and skeleton crew. These COAs would have an impact on the existing dependence of the Marshallese people on USAKA.	
9	Housing is dilapidated and almost at full capacity	
10	IMCOM's mission is base ops; SMDC's mission is missile ops	IMCOM is better at prioritizing base operations and would be better at dealing with contractors than SMDC.
11	Detailed contracts are the key to controlling contractor efficiency	
12	Currently there is not enough oversight on contractors who maintain the base	

For a further description of the terminology for this section, refer to Appendix B.

Chapter 4
Functional and Requirements Analyses

4.1 Importance of Functional Analysis

Defining a system's functions and requirements is one of three essential tasks for systems engineers. A functional analysis is performed at the beginning of the systems life cycle and can be repeated throughout the life cycle. If a system's functions are not defined correctly, the system may not be designed to achieve certain objectives of the system may not be achieved (Driscoll, Henderson, and Parnell, 2011). In our prioritization model we produced a functional hierarchy, functional flow diagram, and IDEF0 model for our functional analysis.

4.2 Functional Analysis Techniques

Functional Hierarchy

The most important purpose of the functional hierarchy is to identify the system functions and sub functions of a system. It is used to guide concept development, design, and help identify performance measures (Driscoll, Henderson, and Parnell, 2011). The top level of a functional hierarchy is the fundamental objective upon which the system is designed to achieve. The layer under that are the basic functions that need to be accomplished for the fundamental objective to be successful. We used stakeholder input gathered from interviews when crafting the functions. Multiple stakeholders specified that the most important functions for the Kwajalein DPW were support of the mission, followed by health, safety and quality of life. Figure 4.1 below depicts the top two levels of our functional hierarchy. Appendx B shows a full description of the functional hierarchy.

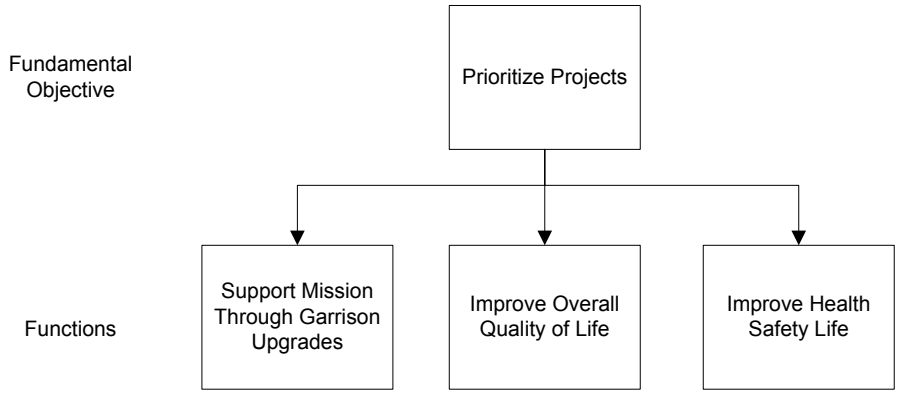

Figure 4.1 *Functional hierarchy*

Two further layers transform the functional hierarchy into a qualitative value model. The third layer consists of the objectives of each function. Each objective, which is maximized, minimized, or optimized, has a value measure, which comprise a fourth level. The functional hierarchy developed with all four layers is a qualitative value model, which is the first step of value modeling. The full qualitative value model is depicted in Appenidx C.

Functional Flow Diagram

A completed functional hierarchy is necessary before creating a functional flow diagram. The interfaces and relationships between functions are the focus in the functional flow diagram. It is used to guide concept development and design of the system and performance measures. Figure 4.2 depicts our functional flow diagram.

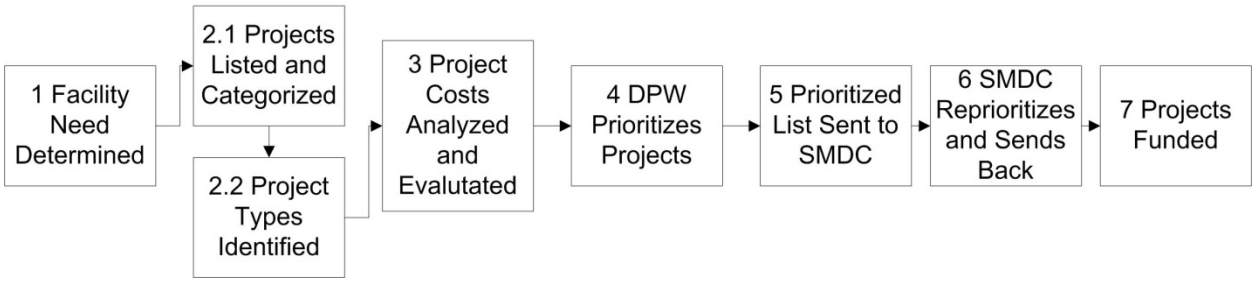

Figure 4.2 *Functional flow diagram*

In this functional flow diagram, it shows the process of how projects are developed and eventually funded. This diagram is useful because it allows for the process to be analyzed and for one to see exactly where the problem lies. The problem in this process occurs between steps 4 and 6. The DPW on Kwajalein and SMDC both prioritize the projects differently and as a result the projects and needs that the DPW sees as beneficial are not getting met.

IDEF0 models are primarily used to communicate the inputs, outputs, controls, and mechanisms of a system to the stakeholders so that they can make decisions and take informed action when needed (Driscoll, Henderson, and Parnell, 2011).

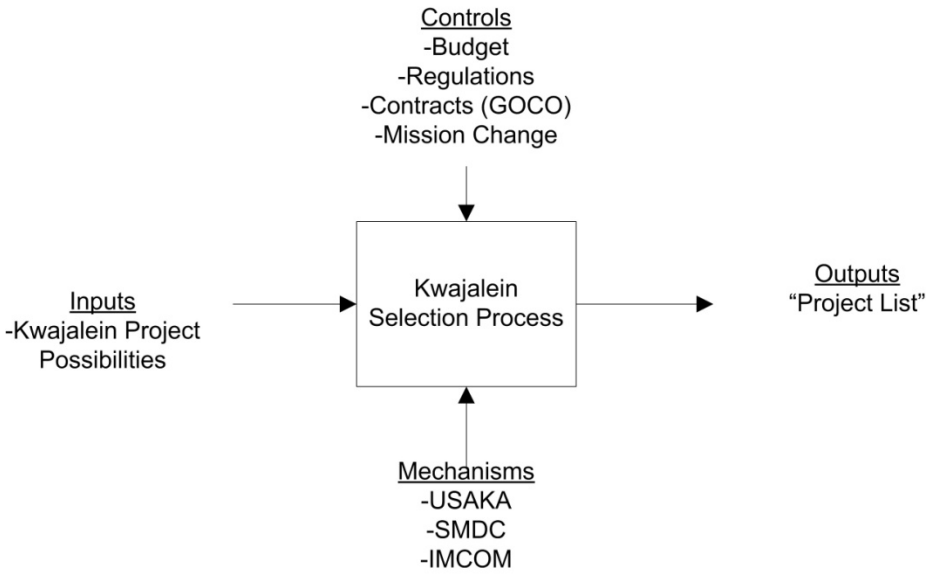

Figure 4.3 *IDEF0 model*

The IDEF0 model is another way to break the process down, of how projects are prioritized, to make it easier to understand. This model makes the process understandable for the stakeholder to analyze to make any changes or decisions. Into the selection process are the actual projects that need fixing (inputs), the decision makers on the projects (mechanisms), and any procedure or constraints they have to abide by (controls). The selection process then produces a project list of prioritized projects to complete (outputs).

Requirements Analysis

A requirements analysis provides specific constraints that must be met and desired capabilities of a system. Each requirement for a system must be objectively produced using stakeholder input and should be traceable to a higher-level operation (Driscoll, Henderson, and Parnell, 2011).

Product at Completion

A thorough understanding of key functions required by the system solution applied to the problem at hand is the most important outcome of functional and requirements analyses. Other important outcomes include an understanding of the relationship between the system functions, and defined, classified constraints that must be met and capabilities desired. Functional and requirements analyses combine with research and stakeholder analysis to provide objectives, functions, and the constraints of a system. With the functions and objectives of the system, we can move to value modeling which will allow us to score candidate solutions. This will lead to the transition to the next phase of the systems decision process, Solution Design. The constraints become screening criteria for candidate solutions during this phase (Driscoll, Henderson, and Parnell, 2011).

For a further description of the terminology for this section, refer to Appenidx B.

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Chapter 5
Value Modeling

5.1 Introduction to Qualitative Value Modeling

Value modeling provides the systems engineering team with an initial methodology for evaluating candidate solutions. For a further explanation of the terminology for this section see Appenidx B. The value model must be sufficient in scope to evaluate the fundamental objective. In our case it must address the effects of all potential projects on Kwajalein.

Fundamental Objective and Functions

The first step was to identify the fundamental objective or the main goal that the stakeholder wants to attain. From our stakeholder analysis we gathered that the fundamental objective would be to "prioritize projects." We determined that these projects would be prioritized by how they supported the mission through garrison upgrades, affected the overall quality of life on the base, and how they impacted the health, safety, and life of the populace on Kwajalein. These three stakeholder values are the functions that directly relate to the fundamental objective.

Objectives

Underneath each function in our value hierarchy is an objective that is meant to further breakdown what is necessary to achieve the entirety of each function. For the objective under the function of "support mission through garrison upgrade," we wanted to maximize the mission readiness. The stakeholders do not want garrison problems to hinder the mission in any way. For the objective under "Quality of Life," our goal was to maximize the quality of life. For our last objective, under "Improve health safety and life," we wanted to minimize hazards, minimize unhealthy conditions, optimize health care, and sustain life. There is a distinction between life and quality of life: life refers to anything necessary to sustain people whereas quality of life focuses on comfort of living.

Value Measures

For each of these objectives, we then needed a way to measure how well they were being achieved. Value measures were then created for each objective to provide that measurement. When putting together all of our value measures, we should be able to cover every project possible in order to give it a measurement that will later be translated into value. Further Description of these value measures can be found in Appenidx C.

The Iterative Process

We completed many versions of our value hierarchy and conferred with our key stakeholders several times to ensure our value hierarchy met their needs. After several iterations, we came to an agreement with the stakeholders on a final version. The stakeholders had agreed to previous versions, but we felt that our infrastructure value measures were too complicated and future users would not be able to understand them. Specifically we attempted to use a complicated system of measuring infrastructure and mission support through a combination of a certain system's likelihood of failure, detestability of failure and severity of failure if failure occurs.

Impact

A friction point we encountered as we defined the levels of the value measures was from our previous step. We struggled with defining risk and impact. After several weeks of discussion about several ways to measure this factor, we finally decided to measure supporting the mission, sewage infrastructure and water infrastructure with the term 'impact' which would be a scale from 0 to 100 to describe how much a project affects these areas. The process of brainstorming and defining all levels for all value measures took several weeks to accomplish because we met frequently over video teleconference with our stakeholder.

5.2 The Value Functions

Developing the Value Functions

When our key stakeholder was satisfied with our value functions, we developed the quantitative scales. Some of our functions were easy to scale while some were complex and thus quite difficult to produce a scale. These difficult functions required more communication with our primary stakeholder. Table 5.1 depicts each value measure, each level in the scales and the score associated with each level. The differences in the scores between levels were determined by the stakeholder's belief on each level's relative importance.

Weighting the Value Model

After scaling the different measures it is necessary to distinguish between the value measures. To do this we sent a list of the value measures to our stakeholder and got him to rank order and assign high, medium, or low importance to each one. We then took this list and assigned high, medium, or low for its variation in measure range. The measures with less distinction between the highest score and the lowest score had a lower variation. With the two categorizations of high, medium, low, we populated the swing weight matrix, which can be found in

Table 5.1 *Explanation of values measures*

Value Measure	Explanation
Mission Impact	This is how much the project will affect Kwajalein's ability to carry out the mission-set. Components of mission impact include extent of impact and likelihood that the project will affect some aspect of the mission, which are subjectively assessed by DPW on the ground at Kwajalein.
Improvement of Work Conditions	This measures how work conditions in any work environment are improved by a particular project.
Improved Quality of Recreation/Community Facilities	If the project affects recreation or community facilities, this value measure quantifies the largest change the project makes to the recreation or community facilities.
Improvement of Living Conditions	This measures the improvement of conditions in the living quarters of any residents on the island. Any and all housing and billets are included.
Percentage of People Affected (Quality of Life)	Only the percentage of people whose quality of life is affected will be counted with this value measure. Changes to quality of life involve projects that affect living comfort and well-being but do not include changes in terms of health, safety or life-sustainment.
Percentage of People Affected (Health, Safety, Life)	This measures the percentage of people who are affected in terms of gains in health or health capabilities, traumatic and chronic safety and life-sustainment.
Percentage of Structures Affected	This measures the approximate percentage of structures that are affected by a project.
Non-Mission-Essential Work Building Structural Improvement	This measures the largest change to building structure for non-mission essential work buildings. This does not include buildings that have a direct effect on the mission such as the power plant, water plant, command building, and airfield.
Housing Structural Improvement	This measures the greatest improvement to the structure of any housing affected by a project and focuses on improvements that will affect health, safety or life-sustainment.
Mission Essential Structural Improvement	This measures the largest change to building structural improvement that directly affect Kwajalein's mission including but not limited to the command building, airfield, power plant, and water plant.
Mold Abatement in Housing	Any project that affects the mold situation in any and all housing is measured by this value measure.
Mold Abatement in Workplace	Any project that affects the mold situation in any work environment is measured by this value measure.
Sewage Infrastructure Impact	This measures the total impact on Kwajalein's sewage infrastructure. The two considerations of impact are the extent of change the project will make and the likelihood that the project will benefit the sewage situation. Kwajalein DPW assesses both subjectively on the ground.
Health Facility Improvement	This measures projects that improve Kwajalein's health care facility.
Increase Access to Healthcare	This measures any project that increases the access to healthcare for any resident. More value is given to projects that increase access to higher priority patients.
Water Infrastructure Impact	This measures the total impact on Kwajalein's water infrastructure. The two considerations of impact subjectively assessed by Kwajalein DPW on the ground are extent of change the project will make and the likelihood that the project will benefit the water situation.

The swing weight matrix shown in Table 5.2 allows us to quantify tradeoffs between conflicting objectives. The swing weight process took several weeks as we defined each value measure then asked the DPW on Kwajalein to put the value measures into importance order. In addition to what was discussed earlier, we also needed quantifiable data from our stakeholder. After he placed them in an order, he assigned each value measure a swing weight—a value from 1 to 100 that represents its relative importance compared to the others. After the DPW prioritized the value measures, we validated his order with how we would compare them resulting in two or three of the value measures changing order which Mr. Heidle either confirmed or denied.

Table 5.2 *Swing weight matrix for the value measures*

		Level of Importance of the Measure		
		High	***Medium***	***Low***
Variation in Measure Range	***High***	Mission Impact (100) Water Infrastructure Impact (90) Sewage Infrastructure Impact (83)		Percentage of People Affected (Health, Safety, Life) (66) Percentage of Structures Affected (45) Percentage of People Affected (Quality of Life) (40)
	Medium		Improvement of Living Conditions (60) Mission Essential Structural Improvement (57) Health Facility Improvement (50) Housing Structural Improvement (40)	Improved Quality of Community/Recreation Facilities (30) Improvement of Work Conditions (28) Non-Mission-Essential Work Building Structural Improvement (25)
	Low	Mold Abatement in Housing (67)	Mold Abatement in Workplace (36)	Improved Access to Health care (20)

End State

Once we established value functions and the swing weight matrix it is possible to fit solution alternatives as means to solve our redefined problem. Our alternative selection immediately preceded model construction.

Chapter 6
Model Construction

6.1 Model Construction

Alternative Generation

After the problem was neatly redefined in a consolidated problem statement, solutions were considered. Jamie Heidle directed that whatever kind of model we would recommend needed to be easy to use. He would be operating it, but also the model's success would depend on whether or not anyone who replaces him could use it easily. A second major design concern was that for the model to be useful, it needed to be powerful enough to distinguish between similar projects. From these two visions, we developed a plan to produce the model in Microsoft Excel® using multiple objective decision analysis (MODA). We chose Excel® because of our personal comfort and exposure to it.

Value Measure Levels

At the same time we produced the swing weight matrix, we attempted to further define each value measure with levels inside of them. Chronologically, this preceded the completion of the swing weight matrix, but must be discussed to explain how our model grew from the bottom up and not top down. The challenge with creating these levels was to create a level for every conceivable project inside that value measure without having an excessive number of levels or overlapping levels.

A constraint that was encountered was the fact that according to MODA, no value measure may be double counted for a project, so we decided to only use the resulting value from the highest-valued level. For example if a project includes replacing the walls and air conditioning in a mission-essential building, then only the level of air conditioning would be selected because it is more valuable. Deciding on which levels should be under each value measure was an iterative process. As we worked, we realized that some value measures needed to be altered because they overlapped with other value measures or were not broad enough. Once we decided on the levels for each value measure, we asked Jamie Heidle to give each of those levels a score from 0 to 100. This score represents the value a certain level achieves out of the maximum value of 100 for that value measure. Our client decided to order the levels according to which was most important then to assign them values in a linear trend because to him, the difference between each level was about equal.

Interface Decisions

As we built an Excel® file with our MODA data, we determined that it was difficult to input a level for each value measure and that conveying this requirement to the user was extremely difficult. Because of this we began to use macros in Excel® to insert list boxes and buttons. These list boxes allowed us to list every level for every value measure, but when all 16 value measures were placed on the same page, the spreadsheet became unwieldy and very difficult to manipulate.

We coded forms[4] into Excel® that would appear when prompted. Because of their neatness and intuitiveness, the main interface of the model used to input and modify projects currently uses a form for each value measure, and upon being called, each form lists every level for the selected value measure. The forms however, are only used for value measures with discrete levels. For the value measures that are a range from 0 to 100 the model utilizes sliders with a color background implying 100 is the best value and 0 is the worst value. This concluded the input interface of the model and the MODA component of the model, but the issues of outputting a recommendation and a way to do analysis still remained.

Cost Versus Value

In designing the output of the model, we set two requirements: there must be a visual representation of how projects score such as a cost-value plot, and there must be a recommended priority of projects

[4] We utilized the aid of Dr. Bill Jockheck, Cadet Herb Jockheck's father. Dr. Jockheck has an extensive background in computer science and business management systems so he helped in programming and code organization.

according to how projects scored and their cost. The MODA component of the model outputs a total value for every project, and we decided to add a prompt to the process of inputting a project that recorded that particular project's cost. Now that both cost and total value for every project are recorded in the database, we needed to pick a location for a cost-value plot. We built a new sheet to display this graph. To produce a summary of projects for the stakeholder, we also listed each project, its cost, and its value in three ways: alphabetically, descending value and descending cost. This graph and these lists update every time a new project is added to the database. A snapshot of this page can be seen in Appendix D.

Recommendation

Next we started a sheet on which we would recommend a prioritized list of projects and then allow the user to change the order. We used a 'waterfall' method to recommend a priority of projects for simplicity and based on the assumption that the largest projects are most important and have the most second and third order effects. With a given budget, the model selects the project with the highest value that it can afford as its first recommendation. Then, the program subtracts that cost to result in a running budget. The same process then repeats, selecting the next highest-valued project that can be afforded by the budget, until there is no money left in the budget. Adjacent to this order is an identical list, organized in the same way, except this list is labeled "Client Priority" and has an extra column in which the user can add his or her own priority for a project. For example, if addressing mold in the housing becomes the commands first emphasis and they want to address it immediately, the user will place a "1" next to a mold project, and it will become the first project in the order, regardless of its total value. A snapshot of this screen can be seen in Appendix D.

Analysis

In terms of analysis, the cost-value plot previously discussed is a simple surface-level approach to view which projects are dominated by others. However if projects need to be compared in terms other than cost and value, then we have a graph that is populated by every project according to whatever value measure you want measured. For example, if the client wants to see which projects affect the most people in terms of quality of life, he or she just goes to the 'advanced analysis' page and selects "% of people (Quality of Life)" from the drop-down box for one axis of the graph. The other axis could be set to any metric as well. The graph then populates with every project in terms of those two measures and allows the user to see what projects affect the most people's quality of life. A snapshot of this feature can be found in Appenidx D.

Individual Project Report

Because this model will be used by a member of the DPW office at Kwajalein, we believed that one person exclusively making decisions about how to score projects inside the model could be problematic. To combat this, we developed a page called 'Individual Project Report.' This page allows the user to select what project to examine, and then shows how that project was rated in each value measure along with that project's total value, cost and description. There is also a button labeled 'print' on this page that opens print preview and selects the proper print area to place this report on two sheets of paper. An example of this report can be seen in Appendix D.

Help

The final aspect of the model is designed to guide the user through all functions and eliminate time lost from improper navigation. There is a help button on the home page that when clicked prompts a form that provides an overview of how to use the model as well as explains what every function from that home page does. Additionally in cell A1 of every page, there is a help comment that provides direction and clarification of the options on the respective page it is on. Outside of the model the user can reference the Kwajalein Resource Prioritization Model User Manual which provides explanation on how to use the model and can be found in Appendix D.

Weaknesses- Kwajalein-Specific

This model is appropriate for the Kwajalein DPW and the problems they face, but there are shortcomings to the model. The value scoring is based on swing weights provided by our primary stakeholder. His assessment may be different than the next Director of DPW on Kwajalein, and is certainly different from people representing different perspectives to the problem. Because these different perspectives occur, this model is specifically intended and only suited for use by the DPW on Kwajalein.

Architecture

The model was effectively planned on a systems engineering plan, but not on a computer science plan. The architecture of the model is sporadic and not well organized. This is because the model was built from the bottom up and not planned from the top down. The location of databases and their correlation to functions could be more efficient if planned better. As a result of the poor organization many versions of the model were thrown away because they could not support the functions that we wanted to include. The final model was reorganized several times and currently operates well, but the architecture is not as efficient as it could be.

User Compromise

The next largest concern is the user accidentally compromising the model. Because the Visual Basic coding relates numerous sheets and cells to perform operations, the user may attempt to change the wrong cell, resulting in errors and disconnected references. The risk of this occurring is mitigated by providing navigation buttons which prevent the user from accessing databases, and also by providing commented warnings throughout the model with the purpose of deterring the user from changing certain cells after they already select them. Ideally the components of the model that should not be changed would be locked from user editing, but it was not possible to do this and maintain freedom for the code to operate throughout the model.

Journal

In order to track all changes that occur in the model, a journaling feature was added. Every time any action is taken on a project or any other change is made to the model, a record of that event and the time it occurred is scripted in the 'journal' tab. This feature has two purposes. If the model is compromised, it allows someone proficient in Visual Basic to identify where the problem is located and the action that caused it. It also maintains a record of when projects are added, deleted and modified. In the case that multiple users are inputting projects, this would help identify the origin of projects or who made changes.

Improvements

Other limitations to the model include a crowded cost vs. value plot. When there are many similar projects or more than about 12 projects, this plot loses clarity. Also, there is no clearing feature. Suppose at the end of a year, there is a new list of projects to select from. As of now, each project in the model must be individually deleted, but a feature that deletes all projects quickly has applicability. Finally, our recommendation uses a method that considers the projects independently of each other. There is a possibility that combinations of less valuable projects could achieve a higher total value with the budget. This is because some smaller projects could have a greater value density, which is not addressed in the current system. All three of these issues could be resolved in future work.

Future Use

There are three main areas in which the Kwajalein Resource Prioritization Model could be improved in the future. We anticipate this project being advanced as a capstone next year because IMCOM has taken responsibility of the garrison on Kwajalein, and they have expressed an interest in our work. The first area that could be advanced is to increase the flexibility and accuracy of the value measures and their levels. Most of our definitions for the value measures came from a manager's perspective and supported by lower level managers who assess and recommend specific projects. The value measures and their levels could be bettered from input provided by specialists in each of the affected areas to better define where one level stops and another begins. Second, a method we recommend finding a method to resolve the measuring of projects that may score in multiple levels in the same value measure. For example there are

better ways to measure when the operations center is refurbished and the electrical system is replaced as well as the ventilation system. As of now, only the higher-scoring level of the two is accounted for. The third area that requires additional work is the ability for the client to actively change swing weights and value measures. We anticipate this project moving towards an application through IMCOM to multiple Army garrisons. By making the swing weights and value measures flexible, each garrison can personalize the model to their specific needs.

Chapter 7
Conclusions

The defined problem on Kwajalein is that the garrison is currently degrading to a point where it affects the ultimate mission of the base. In order to find a solution to this complex problem we conducted stakeholder analysis. In doing so we did not only interview many people, but also we sent a survey to the Kwajalein populace. Additionally we traveled to Kwajalein to see the base understand the problem firsthand. This allowed us to narrow down the problem and coproduce an effective solution.

The solution that we produced for Kwajalein was a model that prioritized projects based on stakeholder input. Stakeholders wanted projects to be prioritized by mission, health, safety, life, and quality of life. The process used to build this prioritization model was Multiple Objective Decision Analysis, which allowed us to measure the values of the stakeholders so that the model would prioritize projects based on their input.

We chose to use Excel® because of our familiarity, and through several iterations of the model, we produced a final version that combines a simple and intuitive interface with an effective recommendation output.

In the future this project and tool can expand to other Army installations and can be used at the DPW level up through IMCOM. With some fine-tuning, this model can be broad enough to encompass each different garrison and their unique problems.

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Chapter 8
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Appendix A
Kwajalein Trip Report

A.1 Introduction

From 3 January 2012 to 11 January 2012 we travelled to the island to confirm the reported conditions and better understand the garrison's infrastructure. We toured all of the facilities and witnessed the effects of the extremely corrosive environment. On the tours we interviewed managers or representatives at each facility. This allowed us to gain an understanding of the relative importance and urgency of each facility. We were also able to interview new stakeholders such as the president of Kwajalein Range Services, the primary contracting company on Kwajalein and conduct a more in-depth interview with our primary stakeholder, Jamie Heidle, Deputy DPW of USAKA. During the interview with Mr. Heidle we were able to begin our quantitative model that allowed us to model values. This trip had the most significant effect on our project by allowing us to understand the ground truth and fully understand the problem. This knowledge enhanced the accuracy, comprehensiveness, and relevance of the final product.

The goals of the trip included both investigating the ground truth of the infrastructure on Kwajalein and meeting our stakeholders. We wanted to view various components of the infrastructure to see how they compared with what we were told by the stakeholders. Further, we wanted to receive more input and quantitative data from our stakeholders that is necessary to build a full model. Once we arrived on Kwajalein and met a few of the people there, we also adopted a goal unrelated to the project, but to represent West Point. On the first day in Kwajalein, we were asked by some residents to visit the school and answer some of the questions that the students had about West Point and the Army. The whole island had been alerted to our upcoming trip and therefore we adopted a new goal of representing and spreading word about what cadets do at West Point.

On Thursday 5 January, we arrived in Kwajalein and took a tour of the island before we received an in-brief by the U.S. Army Kwajalein Atoll Commander, COL Joseph Gaines. Friday 6 January was our first full day on the island. On this day we toured all of the important facilities and infrastructure on the island to include the Water Treatment Facility, Waste Water Treatment Facility, Power Plant, Air Field, Pier, Hospital and Housing. In the afternoon, we met with Mrs. Cynthia Rivera, President of the Kwajalein Range Services, and attained her perspective on the challenges of Kwajalein as the head of the contractors. In the late afternoon we then visited the school to talk to the students about West Point. On Saturday 7 January we took a helicopter tour of the atoll from CW5 Charles Dodd to Roi-Namur, the northern-most island that the U.S. leases. On Roi-Namur we toured the Power Plant, the Water Treatment Plant, the Waste Water Treatment Plant, the Pier, and the Air Field. After returning to Kwajalein, we sat down with our primary stakeholder to understand his opinion on our quantitative value model and to acquire his input for our swing weight matrix. This not only allowed us to have an open conversation about our stakeholder's values but also enabled the development of the foundation of the prioritization model. Later that night we attended a barbeque thrown by COL Gaines. Sunday 8 January was a non-working day for the people on Kwajalein. Their weekends fall on Sunday and Monday so that they align with the weekends in the U.S. (the international dateline separates the two). At mid-day we barbequed with our primary stakeholder, Mr. Jamie Heidle. On Monday 9 January we accompanied the other capstone group with us on a trip to Ebeye to see what that island was like. We saw a huge difference in how people live in the RMI compared to the comfortable living of contractors on Kwajalein. On Tuesday 10 January we departed after briefing COL Gaines on the accomplishments of the trip.

A.2 Trip Observations – Kwajalein

Over the first three days, our team visited several of the facilities that are essential to sustaining life and operations on Kwajalein and Roi-Namur. Follows are summaries of our findings at each major facility.

Water Treatment Facility

When we visited the water treatment facility, we met with the Liquid Systems Manager, Stanley Jazwinski, and learned that the reverse osmosis (RO) system has a reduced life span because it is exposed to the extremely corrosive salt and wind environment. The open-air shelter is not enclosed and at risk to collapse. There is currently not enough funding to construct a new shelter or ideally a closed building for the RO system that would elongate the life of the system for another 30-40 years. Additionally the piping throughout the island is corroding and has failed in the recent past.

Waste Water Treatment

At the sewage facility we met with the Waste Water Manager, Tom Clouser, who told us that the current system could fail in a month or in ten years. Their largest issue is a deforming wall that could crack and release one of the percolating tanks, rendering the facility useless. Without a sewage treatment plant, the island would have to dump raw sewage into the ocean.

Power Plant

At the Kwajalein Power Plant, we met with Chad McGlinn, the Kwajalein Power Plant Supervisor, and Ed Black, the Deputy Public Works Manager. The Power Plant is in danger of not supplying the island enough power because their diesel generators are approaching the end of their life spans. They are currently over 75% of their life expectancy, and recently the plant has had periods where it could only sustain daily power demands and not mission demands because too many engines were disabled for maintenance.

Air Field

Chief Warrant Officer Five Charles Dodd showed us his major concerns on the airfield and related their significance. Because of surface conditions on the airfield, their current airplane loads are reduced by 180,000 pounds. The taxi lane has fallen below useable standards so the runway is being used to land, takeoff, and taxi. This additional load causes accelerated degradation of the runway. Parts of the runway routinely become loose which can cause serious damage to engines. A major concern about the runway is that it is the most time effective way to transport medical emergencies off the island. Without a useable runway, all medical emergencies would have to be moved via ship which takes days instead of hours.

Pier

Our primary stakeholder, Deputy DPW Jamie Heidle, explained to us the condition and his concerns about the pier. The pier is 70 years old and there are currently several pylons, which have broken in half. The result of the wear is that only part of the pier that is large enough to dock a ship can be used to receive cargo.

Housing

Elaine Hahn, the housing manager took our team on a tour through one of the condemned “New Housing” houses. They are called “New Housing” because they were built the most recently in the 1980s. 89 of 136 of these houses are condemned for mold and other issues that result from the harshly corrosive environment. At other times while on Kwajalein we also toured “Dome” and “Navy” style housing which have similar issues including roof leaks, but to a less critical degree.

Hospital

We toured the hospital and met with the Hospital Administrator, Beth Turnbaugh. The building was built as an administration building in 1951 and has been retrofitted as a hospital. As a result pipes hang low from the hallway ceilings, gurneys cannot fit through many doorways, there are venting ducts on the outside, and the only way to move a gurney from the first floor to the second is by pushing it on an outdoor ramp (a concern because the operating room is on the second floor). Fire detection is poor and there is no fire suppression system. Additionally outdated fiberboard is still in place for insulation. The oxygen system is currently off line because the lines were ruptured when the roof was being cleaned.

Contractor Input

We met with Cynthia Rivera, President of Kwajalein Range Service to discuss concerns of the contractors on the island. From her perspective, the largest concern is safety for the contractors. There are many work sites on the island that have severe structural damage from the environment and pose hazards to people in and around them.

A.3 Trip Observations – Roi-Namur

Airfield

On our flight to Roi-Namur, CW5 Dodd showed us the major concerns with their airstrip which has the same problems as Kwajalein but is in slightly worse condition.

Power Plant

Plant Supervisor Scott Maddox shared with us his major concerns with the Roi-Namur power plant. Because of the heavy loads induced on the electrical grid by massive radar movements, the power plant is required to run at a power factor of about 0.7 translating to three to four generators running at all times except during missions when they run five. These engines are only about half way through their life expectancy, but the plants major concern is the exhaust stacks which are rusting through in the middle and could eventually take three generators off line. Additionally corrosion could also deadline the radiators as the fins on the cooling coils are rusting off.

Water Treatment Facility

Daniel Barge, the operator of the water treatment facility told us that when the filtration system fails they can generally repair it, and if it fails for any period of time, they have a completely secondary RO system. The piping on the island is as bad as it is on Kwajalein and has failed in the recent past. The electrical system that controls the filtration system is also out-of-date and occasionally fails.

Waste Water Treatment Facility

Dwight Dearmon, Waste Water Operator Three told us that the current sewage system is not very old, operating below capacity, and has no concerns for any kind of failure in the next few years. The only design issue with the plant is that the outfall pipe is eight feet below the water surface and not 30 feet deep which fails to meet Environmental Protection Agency code.

Data from Jamie Heidle

Our team discussed our quantitative value model with Jamie Heidle, our primary stakeholder. We drew his input on the relative importance and impacts of each type of infrastructure which is represented in the swing weight matrix. We also obtained his perspective on what the value functions should look like, what value measures would not be good to implement and his tastes on what the interface of the final model should be. We eventually interviewed him again on the importance of each value measure because we revised our value model after arriving in New York.

A.4 Summary

As a result of this trip, we were able to confirm reported conditions at all infrastructure sites on Kwajalein and Roi-Namur. Table A.1 summarizes the findings from some of our interviews. In many cases the damage and disrepair were worse than what we expected from descriptions alone. Seeing the facilities and discussing their importance with local operators made it much clearer which facilities needed fixing and which could possibly wait. We were able to draw quantitative data from Jamie Heidle in order to start our quantitative modeling process. Two other impacts from this trip are that we need to include projects on Roi-Namur in our model and the rediscovery that we needed to represent stakeholders at SMDC in order to solve the communication gap between these two organizations.

Table A.1 *Findings and conclusions based upon our visit to Kwajalein*

Category	Findings	Conclusions
Money	Preferred outcome: a priority model such as a matrix	It costs too much to repair everything so a prioritization of projects is necessary
	Determine the costs between the FY 13 – FY 18, and increase it to an IMCOM standard, a Q2 amber rating. It's over a seven-year period. It costs $130-150M a year. $950M to operate over 7 yrs. To operate and repair, over $1.5B. This is too big so they need to come up with an alternative solution. 15 November is the next meeting with that General Kerelli –in this they will brief these courses of action to improve Kwajalein.	
	The cost to bring the base up to Army standard which is below IMCOM standards is $500M.	
	Cost went up because they need to fix the whole thing	Major milcon needs to happen because all these projects are expensive and USAKA is underfunded
	They are underfunded. So they asked for additional funds from DA, they got some funds over $31M They are in the process of getting them into contracts. The way that list was put together was going through previous workplans. They had identified a need for and never did anything and worked through commander's wants, what was going to have the biggest impact on mission if failed.	
	If housing was in compliance with Army standards, they would get 3 to 4 million extra a year to fix them up. They don't fall under the regulation to meet the housing Army standards.	
	DPW gets $31M every year for its Sustainment, Restoration and Modernization (SRM) program (formerly Real Property Maintenance)	
	Cost ratio between 2.67-2.96	
	$120-130M for cost of Hospital	
	$62M for cost of pier	
	$750,000 is considered a military construction project, or a Major MILCOM project, which has to be approved by congress.	
Priorities/Goals	Kwajalein hasn't had a major construction project in 10 years, so all the infrastructure here is failing.	Lack of funding and oversight over a generation caused the current problem
	HQ-commanders of SMDC, contractors, and DPW are responsible for letting it get that bad	
	His focus is on the space and missile defense, base operations are not his core competency	
	3 guys overwatching hundreds of contractors	
	The last milcom project and paint facility was done in 2003. It was a military vehicle painting facility	
	He has never seen an installation this bad of shape, it got that way from a lack of funding through out the years	
	It's evolved this way over 20-25 years. And they didn't have a dpw in the past.	
	The base is on the brink of failure. There are only two things to do:	
	o Put money into it	
	o Move people off the island	
	COL Gaines wants to convince Army that they are not properly funded and need money.	The money available goes towards mission needs
	Money not fenced, they get the money for a project but it can be taken away.	
	SMDC took an $18M budget cut, so he took out maintenance to housing. It is a balancing act between fixing radars and housing, and radars win most of the times	

	Criteria: biggest impact if failed, # peple impacted, life health and safety, worst first, Installation Status Report (ISR), What is actually executable, and inspection results.	Priority goes to infrastructure that impacts mission, and then to infrastructure that impacts health, safety, and quality of life.
	How to prioritize Milcon:Army prioritization-Army programs like BRAC and grow Army. Look at whats in worst condition and biggest threat to mission. Use ISR, Commander's priorities (worst first). Example of other stakeholders: kwaj only hospital not under medcom, and only not under Netcom for IT	
	SMDC prioritizes by the Army's needs. What are the things in the worse condition, or what events prevent the mission, or prevent something on the ground. They use some kind of ratings. They fix the worse first. Work in the commander's priorities, the other staqkeholders priorities. Kwajalein is the only place in the Army operated not by medcom. Netcom for IT? Range customers take into account. Life, health and safety risks.	
	1st Goal: To support the mission.	
	Standard by which you prioritize projects- mission, health, safety of life, and quality of life.	
	SMDC primary goal is to support mission	
	Airfield and pier is how they get their supplies. So this is why these two are more important than the housing. And if it becomes an unaccompanied tour than these homes will not be needed anymore.	
	Because of the condition and degrading of pier, significant weather could cause a loss of those piers. This would cause them to lose the ability to get supplies, it would be a crisis	Airfield and Pier are 1st and 2nd because of their direct impact on mission
	A significant weather event would throw the timelines off as well.	
	If they don't repair the airfield and pier in 36 months, they will face mission failure, if they don't get the MILCOM project	
	The airfield and waterpower are degrading greatly.	
	Every 5 years do inspection on airfield (USACES)	
	The second priority is Echo pier.	
	Airfield- which is rated red. The airfield is the currently the most urgent. They get the most immediate supplies by aircraft, not by ship. Medical issues, fresh fruit and vegetables, mail, and critical mission parts by air. They receive by ship the bulk supplies such as POL products and fuel, most of dry goods-building materials, vehicles, and food stocks. They get two ships a month; their path is from San Diego to Guam, then to Kwajalein.	
	The first priority is the transportation infrastructure.	
	No heavyequipment	
	Cant use main port (deep part)	
	Milcom airfield pier, you cant drive heavy equipment around the deep side, so the ship has to load and offload on the shallow, but it cant use the big crane on the shallow side, so it slows down the process/ the cost went up bc the pier is condemmed and it is degraded.	
	Both the airfield and pier are direct mission support: the faiure of one of them would result in mission failure.	
	Echo pier second higest Priority	
	2nd Goal: Infrastructure. For IMCOM specifically the airfield and pier, if those things fail then the mission fails. Then the hospital is the next priority. There are no new requirements out there to build anything, just repair.	
	He would rather have an airfield than anything else. He doesn't	

	see the need for a hospital, a clinic would be fine.	
	His Ranked Priorities of projects o Airfield o Pier o Hospital	
	They cannot get a commissary because they only have a small number of military personnel. The big military does not realize that contractors cannot go anywhere else to get food.	There are a variety of other projects to include housing, waste water treatment, hospital and power plant that need to be prioritized
	We don't have a military treatment facility there, just a hospital run by contractors. They cannot get one there because they don't have enough military personnel. Contractors are not taken into consideration and the big military overlooks Kwajalein.	
	They have to send up a military construction list every year. Critical failures can be catastrophic because they can't depend on anyone else as an island.	
	Do they consider their housing adequate, do they have any conditions with their house-mold, leaking roofs, electrical problems and what they think of the responsiveness of repairs, is the square footage of their house accurate, how do they feel about abandoned buildings in neighborhood-major issue non issue.	
	They provide their own water, electricity, etc.	
	Power plant stacks must be repaired, sewers repaired, also 5 or 6 projects that have to be done in the next 12 months.	
Courses of Actions (COAs)	He hopes to get houses up to where no roof leaks and there is no mold	
	He does not want sub standard housing. 50% of roofs leak and mold fills these houses. His biggest concern is the buildings that people live in.	
	Fixing the roofs, is primary, hopefully it starts at the beginning of the fiscal year if they get funding for it	
	Sewer went to Naval Facilities Command for cost analysis	
	Sewer and waste water treatment were in "dire straights" –fire detection sytems and sprinkler systems were bad.	
	Water treatment plant and the power plant are rusting heavily and close to mission failure.	
	They focus on restoration and modernization. (They take Kwajalein priorities and form them into 1391s and then they go to compete up at the Army Staff level.)	
	The decline of facilities is primary concern because it is a very corrosive environment and chronically underfunded.	
	3: Housing conditions- they have hazardous conditions with mold. Discussion about whether it should be an accompanied or unaccompanied tour, which will be determined November 15. RMI nationals would no longer be required. Highest Army level will make those decisions because of the loss of revenue for RMI. It is sufficient for an unaccompanied tour.	
	Other big concerns: The wastewater treatment plant. Spalling repairs that have caused damage over time. Passenger service terminal. If the walls collapsed you would have raw sewage in the reservoir. They have wood structures built bc of the spalling corrosion. The concrete splits and falls down on people's heads. The wooden structures prevent the concrete from falling and hitting people in the head. You have the lodging facility for the same thing. Air traffic control facility passenger service terminal has the same problem.	

	They fund those studies. Engineers at Vicksburg designs those study's. They went to Naval Engineering Facilities Command and asked for an AE expert, to do underwater pypes and perform a cost analysis.	
	Environmental concerns based on assessments (fixes)?	
	Impacts on life health and safety. Whats going to fail first, use the isr rating for that. Or inspections for that. An inspection.	
Contractors	ISR black the hospital facility. MEDCOM builds, this was built under the Navy, they don't have the population that would require a full hospital like they have. The hospital would not be required for the contractors. Specifically stated that contractors can't use military housing, but they are using it.	
	COL Gaines wants to demolish first row of houses in next 12 months	
	Overall good relations with USAKA between Marshallese people. There education is poor and they think when cutdowns happen more Marshallese people will get cut then Americans. For every 1 person that works on the base, they support 20-30 people on Eybeye.	COA's could change the prioritization. Such examples are unaccompanied tours, fixed firm contracts, skeleton crew. These COAs would have an impact on the existing dependance of the Marshallese people on USAKA
	There were 5 decisions that will be determined: Kwajalein will remain under SMDC, Come under pacific region for oversight management, Take an accompanied or unaccompanied, Remain status quo, Come under IMCOM	
	IMCOM wont take over until they get word from drawdown study	
	Army Resource Command wants a cost benefit analysis.	
	Implementation of IMCOM takeover would be immediate. The memorandums of agreement would be immediate. The unaccompanied decision would not be immediate, it would not be implemented till FY 13, summer of 2013, b/c it would mess with families and their kids in schools.	
	The current contract is expected to expire February 2013. They would kick out the families at the end of FY 13.	
Current Status	If they get the budget they say they need, they would say 5-10 year timeframe, 10-15 yrs though best case scenario probably to an acceptable quality standard. Its difficult to keep things going on the airfield while under construction, so only so much construction can happen. Cost module that gives you a rough cost of what it would take to bring them up to quality; try to bring things up to Q2 (amber).	
	Family housing could be removed	
	Can be an unaccompanied tours	
	Because of the fiber optics it would allow all the scientist and radar trackers, etc. to work in Huntsville.	
	He Values the drawdown or suggestion to move away from Kwajalein. He would want people to get sent their on TDY, for mission tours, and have only 100 workers their instead of 1500 workers. The cost to fix up the place doesn't outweigh keeping it going there, it can be done somewhere else. So small force over in Kwajalein. There is a study going on right now to see if it should stay opened.	
	He wants to get away from GOCO, and go to firm fixed price contracts.	
	The contractors are also paid to maintain the island. Contractors are paid to do the mission and also to maintain the facilities. They are not fully staffed because GOCO takes the place of that. There is only 16 military personnel, so they can save military personnel for the fight	Currently there is not enough oversight on contractors, who maintain the base

	Contractors run it, while DPW oversee it. But there was no DPW, so there was no oversight.	
	Currently all base operations are done by contractors.	
Problem	Challenges with GOCO are how the performance contracts were written. What is best business is not vague. The amount of government oversight to make sure it is being performed	Detailed contracts are the key to controlling contractor efficiency
	They control contracts write it in detail and go into negotiations with the contractors.	
	IMCOM can create efficiencies in the contract to save money	
	If you leave it vague its cheaper, but you don't get performance (contracts) Should be specific to get the performance wanted.	
	Their core competency is SMDC not base operations. SMDC see installation management as the secondary mission	IMCOM's mission is base ops, SMDC's, mission is missile ops
	SMDCdoesnt approve the projects and put the money in different projects, or they modify the priorities.	
	IMCOM focuses on base operations.	
	SMDC knows little about logistics and Base operations	
	IMCOM would have a real assessment team on the ground.	
	IMCOM wont take over until they get word from drawdown study	
	None of these projects are restricted by Net Zero. They are standard Army projects.	
	A team in Hawaii has already done a functional analysis	
	There are three types of housing: Dome housing (made in the 50's and 60's), navy block housing, new housing built in the 80's. The most liked in order are: Dome, Navy, New housing.	Housing is old and almost at full capacity
	1000 contractors, 16 military, and 52 DOD workers	
	They currently have 5 levels of housing: A,B,C,D,E	
	Current rating goes to rank/GS level and family size	
	518 slots/rooms for BOQ and they are 90% full, some are double rooms. There are 366 housing units	

Appendix B
Research and Stakeholder Analysis Definitions

Miscellaneous

Stakeholder—A stakeholder is any person or party that has a vested interest in the system or its outputs (Driscoll, Henderson, and Parnell, 2011).

Client—The stakeholder who principally defines the problem or solicits decision support for the system.

Owner—The stakeholder "responsible for the proper and purposeful system operation" (Driscoll, Henderson, and Parnell, 2011).

Decision Authority—The stakeholder with "ultimate decision gate authority to approve and implement a system solution" (Driscoll, Henderson, and Parnell, 2011).

FCR Table—A Findings, Conclusions and Recommendation table is a three columned table used to organize like needs, wants and desires form stakeholders and progressively group and summarize them until a small list of recommendations is produced.

Functional and Requirements Analyses

Function – "A characteristic task, action, or activity that must be performed to achieve a desired outcome. For a product it is the desired system behavior. A function may be accomplished by one or more system elements comprised of equipment (hardware), software, firmware, facilities, personnel, and procedural data" (Driscoll, Henderson, and Parnell, 2011).

Functional Analysis – A systematic process to identify the system functions and interfaces required to achieve the system objectives

Functional Hierarchy – A hierarchical display of the functions and sub functions that are necessary and sufficient to achieve the system objectives.

Functional Flow Diagram – A flow diagram that depicts the interrelationships of the functions.

IDEF0 – IDEF0 stands for Integrated Definition for Function Modeling and is a modeling language with associated rules and techniques for developing structured graphical representations of a system or enterprise (Driscoll, Henderson, and Parnell, 2011).

Requirements Analysis – "The determination of system specific characteristics based on analysis of customer needs, requirements and objectives; missions; projected utilization environments for people, products, and processes; and measures of effectiveness" (Driscoll, Henderson, and Parnell, 2011).

Value Modeling

Fundamental Objective—The holistic objective of the system that the stakeholder wants to achieve.

Value Measure—A metric used to determine whether or not an objective is being achieved.

Qualitative Value Model—Description of the qualitative values that include the fundamental objective, functions, objectives, and value measures.

Value Hierarchy—Value tree used to depict the qualitative value model.

Tier—Any level in the value hierarchy (Driscoll, Henderson, and Parnell, 2011).

Weights—Weights are assigned to a value measure to show how important each is in relation to the others.

Score—A number used to estimate the future performance of a candidate solution.

Value Function—A function used to assign value to the score for each value measure by translating another metric (rating, miles, number of people, etc.) into value.

Quantitative Value Model—A combination of value functions and weights used in an equation to evaluate candidate solutions.

Global Weights—The ratio of the individual measure weights for each value measure to the sum of all measure weights.

Appendix C
Qualitative Value Model

Because the qualitative value model is too large to fit on one page, it is broken up by functions.

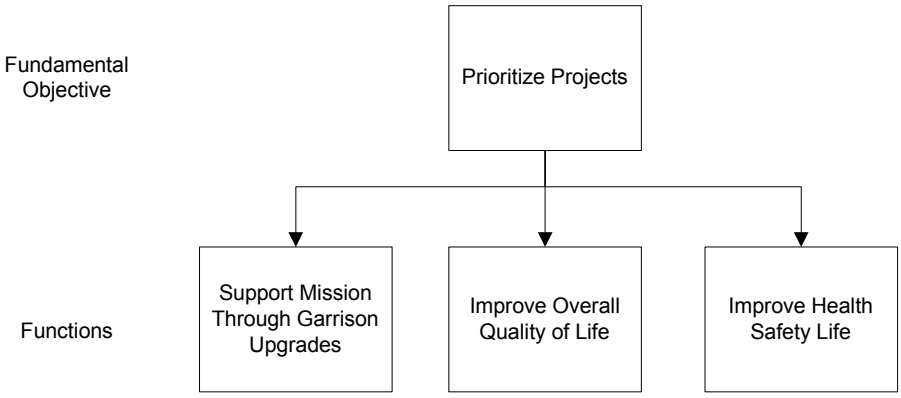

Figure C.1 *Top-level value model*

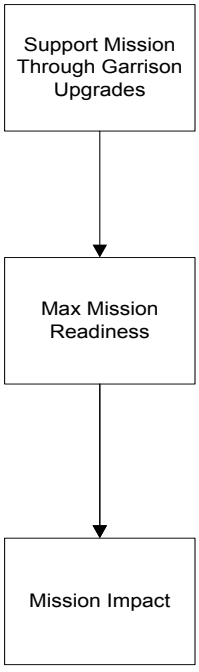

Figure C.2 *Support Mission Through Garrison Upgrades Function*

Figure C.3 *Improve Overall Quality of Life Function*

Our third function, Improve Health, Safety, Life is our largest and most complex function. To show it in detail I have the function broken into the objectives on this page and the value functions that accompany each objective will be shown on different pages and is shown in Figure C.4.

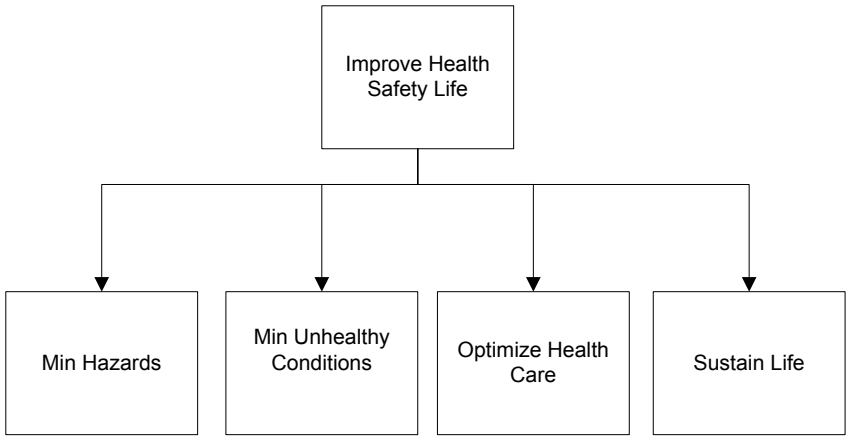

Figure C.4 *Improve Health, Safety, and Life Function*

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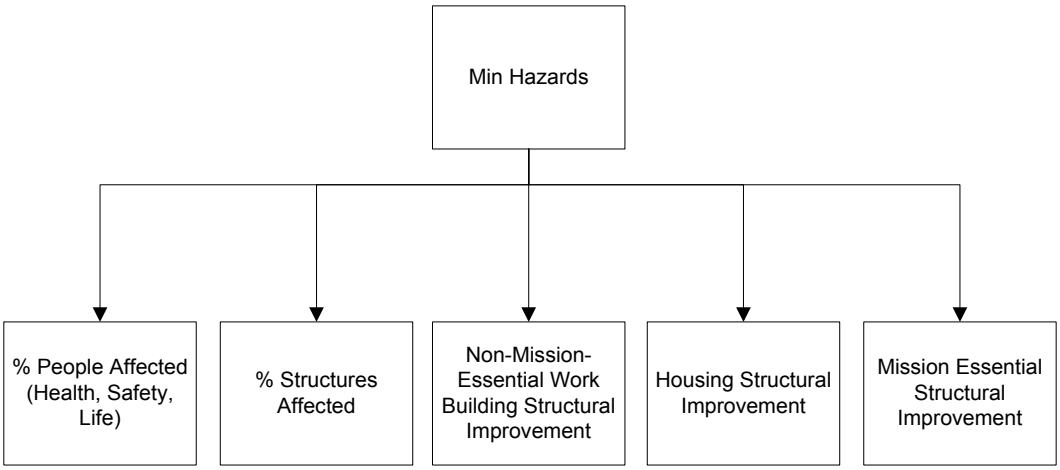

Figure C.5 *Minimize Hazards Value Measures*

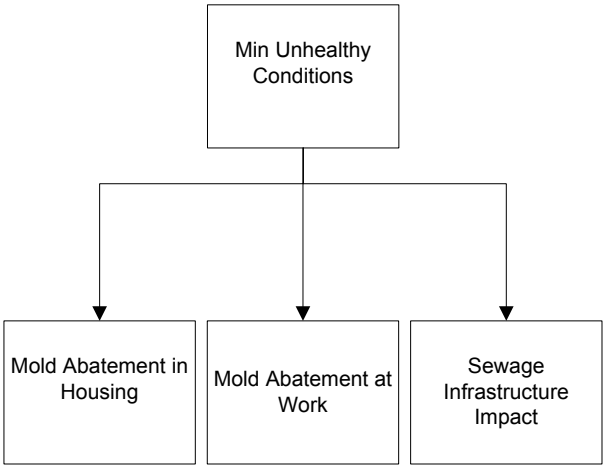

Figure C.6 *Minimize Unhealthy Conditions Value Measures*

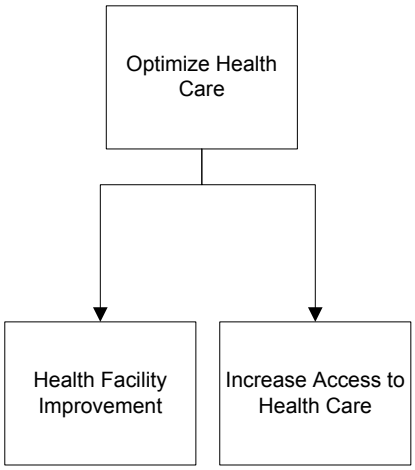

Figure C.7 *Optimize Health Care Value Measures*

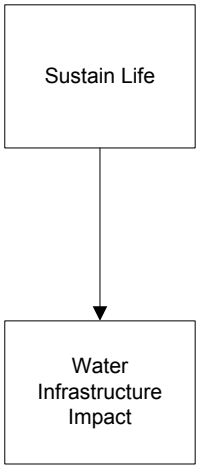

Figure C.8 *Maximize Sustain Life Value Measures*

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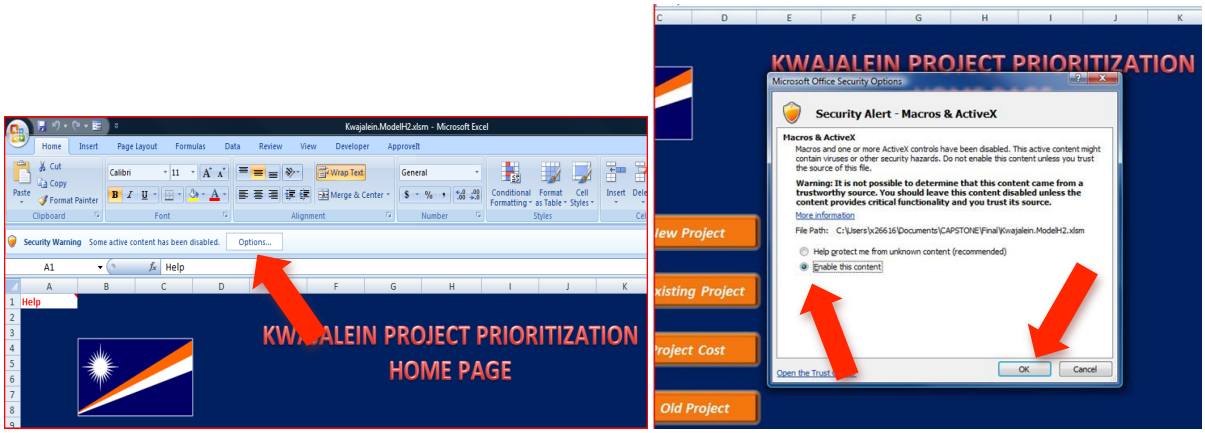
Appendix D
Users Manual

D.1 Kwajalein Resource Prioritization Model Help Manual

The purpose of this manual is to provide assistance to users of the Kwajalein Resource Prioritization Model. The model is designed to provide an objective prioritized list of projects based on the values of the Kwajalein Department of Public Works. Data must be entered for every project on the table as well as the total budget for the decision period.

D.2 Details of User's Manual

In order to use the model, macros must be enabled in your workbook. After opening the Kwajalein Resource Prioritization Model, a security warning should appear that says "Some active content has been disabled." The user must click the nearby "options…" button then select "enable this content" and click "ok."



Enabling Macros

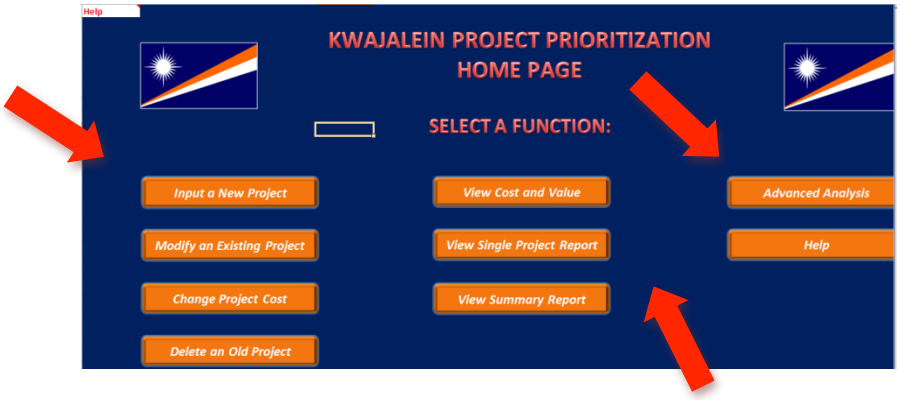
On every page, cell A1 is commented with help information for that page. To access this information, the user must move the cursor over cell A1. Moving the cursor away or just selecting the cell will not show the comment. Additionally, on the homepage there is an orange button that when clicked prompts a form with help information.

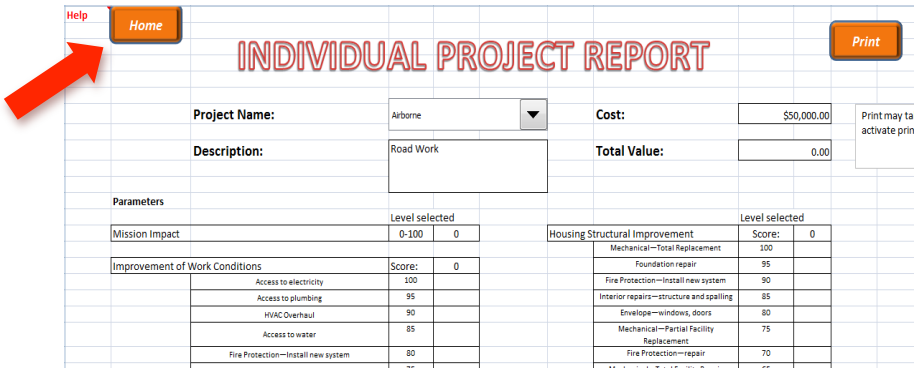
Help Location

It is recommended that the user 'saves as' a copy of the model with the date he or she is working on it. The user should maintain an original copy and a current copy so that the original can be recalled at a later time if needed.

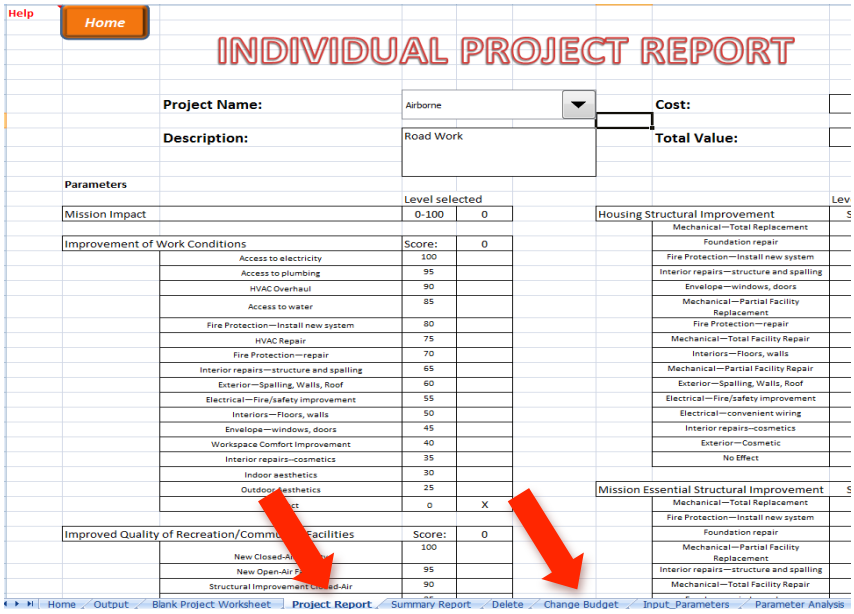
Do and Do Not

- DO use the orange navigation buttons to move between pages.
- DO NOT move between sheets by selecting the tab at the bottom of the window. Doing so could expose the user to opportunities for critical errors.
- DO NOT change any cell in “Raw_Database” or “Value_Database.”





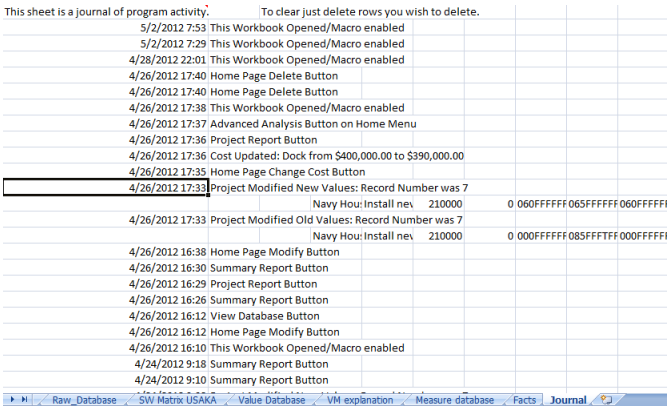
DO Use the Orange Navigation Buttons



DO NOT Use the Work Sheet Tabs to Navigate the Model

What to do When Things go Really Bad

In the case that a "Run-time error" appears, only attempt to fix if you have a background in Microsoft Excel Visual Basic (VBA). The error is most likely caused by a recent user action that mis-aligned a reference. If no expert is available it is recommended to close the program without saving, then try to open the last saved version. Test this version to see if the same error occurs. If it does, terminate the program and begin work again with your original copy of the model. If an expert is present to help fix an error message, he/she can access a tab titled "Journal." This sheet is a list of every action taken in the model and can be used to help pin-point when and where a problem was created.



Journal Page

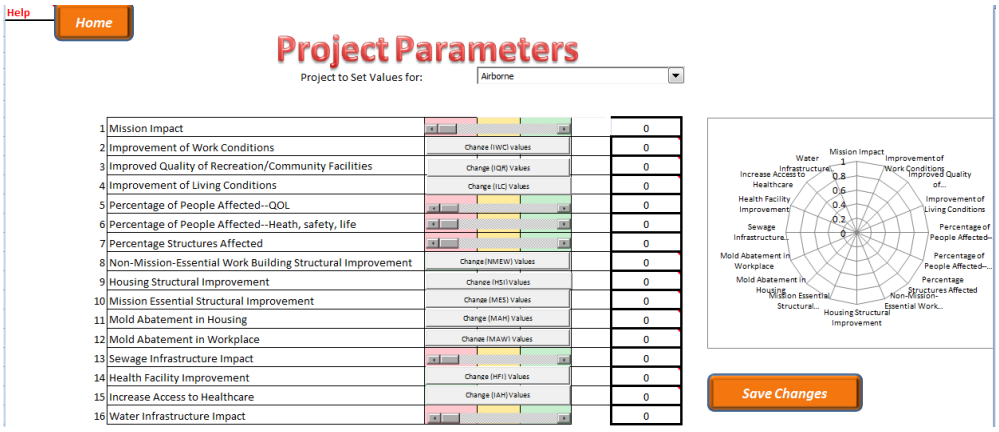
Explanation of Pages and Features

This is the page that appears when the program starts and is the page that connects to all other available pages.

Home Page

Input a New Project

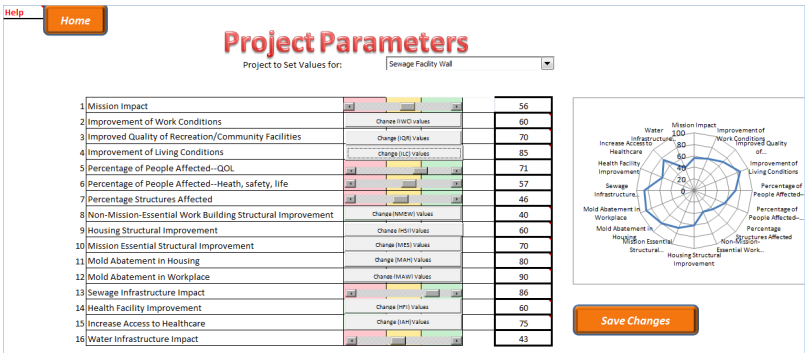
This function will add a new project to the database. First the user is prompted to type a project name, then a project description, then cost. Finally, the user must select the levels for each value measure and save the project.



Input a New Project

Modify an Existing Project

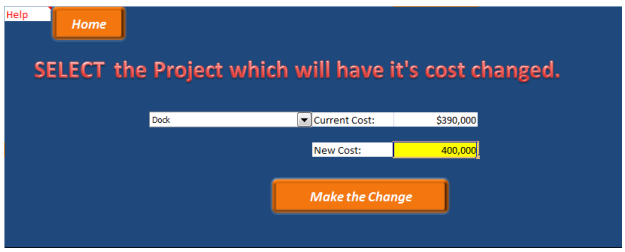
This button takes the user to the Input Parameters page and gives the user the option to select a project with the drop-down box. Then the user changes the levels and saves the project's changes.



Modifying an Existing Project

Change Project Cost

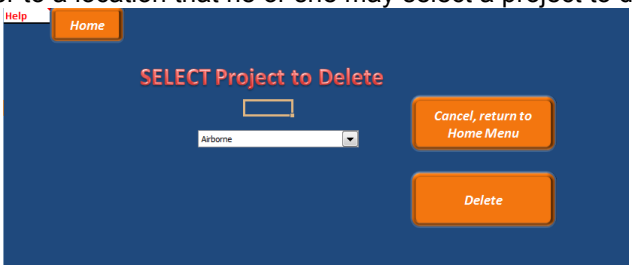
This function takes the user to the "Change Budget" worksheet which allows the user to select a project, see the current cost, type a new cost and save the change.



Changing a Project Cost

Delete an Old Project

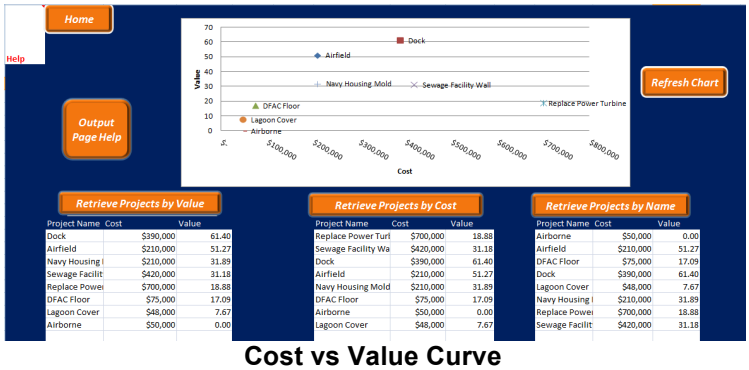
This function takes the user to a location that he or she may select a project to delete, then delete it.



Deleting a Project

View Cost and Value

This button shows the user a cost vs. value graph with all the projects plotted on it. The chart may not automatically update, so it may be necessary to select the "Refresh Chart" button. Below the chart are three lists. Each list contains the same data, but organized in different ways: by value, cost and alphabetically. As new projects are added, it will be necessary to "Retrieve Projects by…" to put the new projects into the proper order.

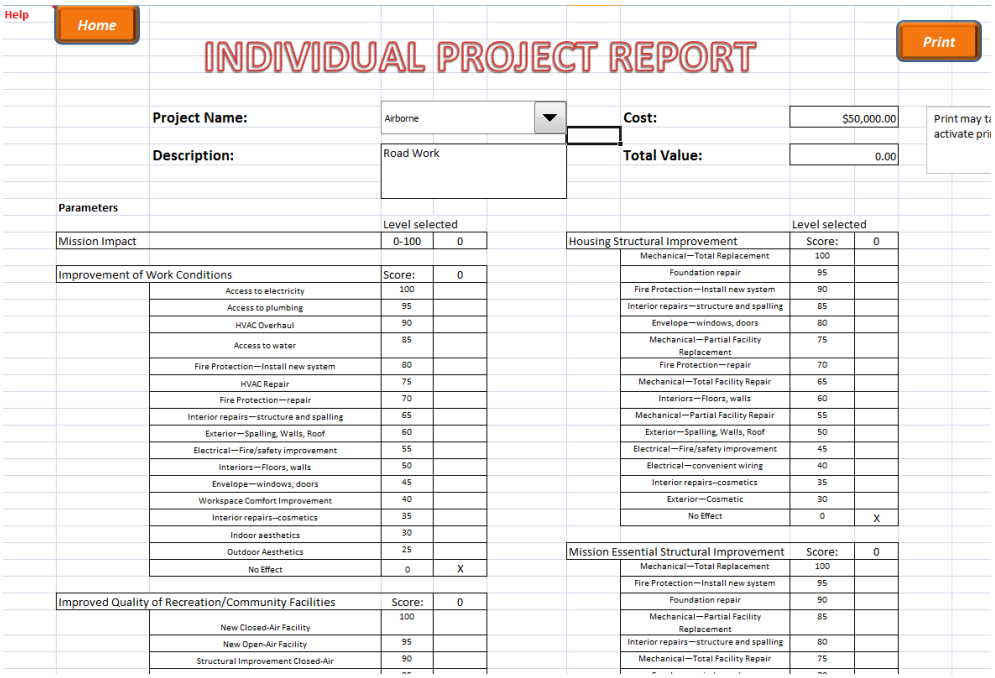


Cost vs Value Curve

View Single Project Report

This button takes the user to a report that shows how a single project is scored. The user must select which project to view with the drop-down box. That project's cost, description, and total value as well as every level it scored with will load into the report.

Selecting the "Print" button, will set the print area and open print preview. If the user prints from here, a two-page report will print.



Help Home

INDIVIDUAL PROJECT REPORT

Print

Project Name:	Airborne	**Cost:**	$50,000.00
Description:	Road Work	**Total Value:**	0.00

Print may ta
activate pri

Parameters

	Level selected	
Mission Impact	0-100	0

Improvement of Work Conditions	Score:	0
Access to electricity	100	
Access to plumbing	95	
HVAC Overhaul	90	
Access to water	85	
Fire Protection—Install new system	80	
HVAC Repair	75	
Fire Protection—repair	70	
Interior repairs—structure and spalling	65	
Exterior—Spalling, Walls, Roof	60	
Electrical—Fire/safety improvement	55	
Interiors—Floors, walls	50	
Envelope—windows, doors	45	
Workspace Comfort Improvement	40	
Interior repairs–cosmetics	35	
Indoor aesthetics	30	
Outdoor Aesthetics	25	
No Effect	0	X

Improved Quality of Recreation/Community Facilities	Score:	0
New Closed-Air Facility	100	
New Open-Air Facility	95	
Structural Improvement Closed-Air	90	

	Level selected	
Housing Structural Improvement	Score:	0
Mechanical—Total Replacement	100	
Foundation repair	95	
Fire Protection—Install new system	90	
Interior repairs—structure and spalling	85	
Envelope—windows, doors	80	
Mechanical—Partial Facility Replacement	75	
Fire Protection—repair	70	
Mechanical—Total Facility Repair	65	
Interiors—Floors, walls	60	
Mechanical—Partial Facility Repair	55	
Exterior—Spalling, Walls, Roof	50	
Electrical—Fire/safety improvement	45	
Electrical—convenient wiring	40	
Interior repairs–cosmetics	35	
Exterior—Cosmetic	30	
No Effect	0	X

Mission Essential Structural Improvement	Score:	0
Mechanical—Total Replacement	100	
Fire Protection—Install new system	95	
Foundation repair	90	
Mechanical—Partial Facility Replacement	85	
Interior repairs—structure and spalling	80	
Mechanical—Total Facility Repair	75	

Single Project Report

View Summary Report

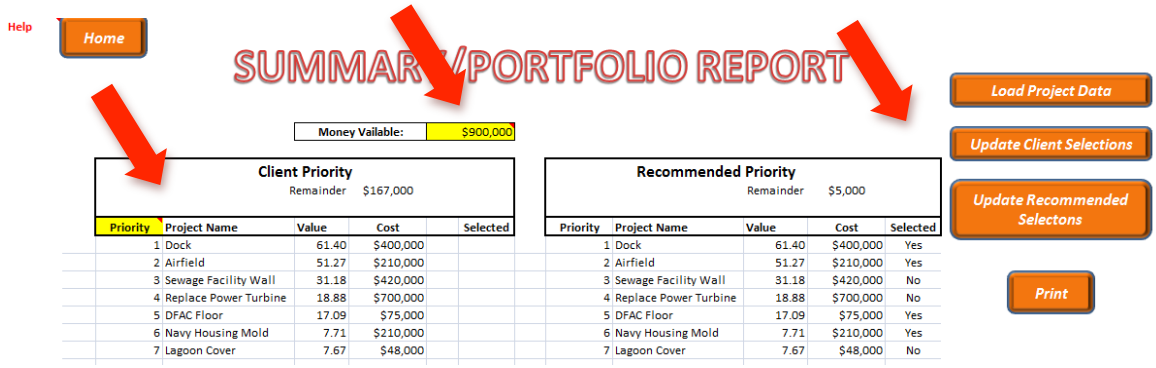
Selecting “View Summary Report” will show the user two lists and the current budget. The user needs to input a value into the cell next to the label “Money Available.”

The column summary on the right lists projects in priority based upon the model. A “Yes” appears next to the project if there is enough money in the budget and if project has a higher value than similar or more costly projects.

The left column summary represents the Client’s Priority. In column C, the user can change the priority of a project according to his or her needs and wants. If a project needs to be funded, place a “1” for that project’s priority. If a project must move from a funded position to a low priority, then change its priority number to a high number. After these changes are made the “Update Client Selections” button must be selected. The model then prioritizes the projects according to the same method above. Additionally, those projects with a changed priority will move to their new positions.

Note if a new project has recently been added, the user must select “Load Project Data” and “Update Recommended Selections” in order to have an accurate recommended priority list.

Selecting the “Print” button, will set the print area and open print preview. If the user prints from here, a two-page report will print.



Summary Project Report

Advanced Analysis

The purpose of this page is to allow the user to view how each project compares in terms of each value measure.

Selecting this function will take the user to a cost vs. value graph. Below the graph are two drop-down boxes. With these boxes, the user can select any value measure. After selecting the desired value measure, cost or value, he or she must click “Refresh.”

Advanced Analysis

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